

**STANDARD SPECIFICATIONS FOR
DESIGN AND CONSTRUCTION OF WATER LINES
AND SEWER LINES**



2012 EDITION

The 2012 Standard Specifications for Design and Construction of Water Lines and Sewer Lines was prepared by the Utilities Department of the City of Fayetteville.

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SECTION 1000

GENERAL REQUIREMENTS AND PROCEDURES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. These Specifications for water design and construction are provided to outline the City of Fayetteville's procedures and minimum criteria for the design and construction of water and sewer lines within the City of Fayetteville, Farmington, Greenland, Goshen, Johnson, and all other areas within the City of Fayetteville's water and/or sewer distribution and collection systems. **Throughout this document, the name City of Fayetteville shall apply for all entities in the City of Fayetteville Water and/or Sewer Service areas.**
- B. The City Engineer's office is responsible for the issuance of construction permits for the installation of all water and sewer facilities constructed in the City of Fayetteville. Water and sewer facilities shall be designed and constructed in accordance with these Specifications.
- C. A preconstruction meeting shall be held before initializing work. **One full set of construction drawings shall be provided to the Water and Sewer Department before work begins.**
- D. These Specifications set forth the minimum criteria for the design and all work in connection with the construction of water and sewer lines within the jurisdiction of the City of Fayetteville including the entire system and its appurtenances from the water distribution system to the point of connection at the water meter and the entire sewerage system and its appurtenances from the point of connection with the building plumbing to the discharge terminus of the treatment plants' outfalls. The City Municipal Code and all Ordinances of the City of Fayetteville shall be considered a part of these Standards; and all drawings, profiles, cut sheets, easement documents, and specifications shall conform to the standards and requirements herein established. Addenda and/or revisions to these Specifications by the City of Fayetteville may be issued periodically and will be distributed and made available to the public and contractors at the offices of the City Engineer. **Users of this text are urged to review the latest revisions or editions to these Specifications to apprise themselves of any changes/revisions.**
- E. Where the requirements of another jurisdictional authority having influence on work outside the purview of the City of Fayetteville are greater than that provided by these Specifications, the work shall conform to the greater requirement of that respective jurisdictional authority.

- F. The Owners of the project shall be responsible for procuring all necessary permits and licenses, paying all charges and fees, acquiring and recording all easements and giving all notices necessary and incidental to the work.
- G. All construction projects shall conform to these Specifications for acceptance by the City of Fayetteville. All construction drawings and specifications must be approved by the City of Fayetteville before construction begins. **Full time construction observation services shall be provided by the Engineer of record.** Final acceptance testing will be coordinated with the City. The City of Fayetteville shall be given a minimum of forty-eight (48) hours notice prior to the commencement of construction projects for observation purposes. Notice shall be given no later than 10:00 a.m. the day prior to the activity requiring observation.
- H. These Specifications are provided with the intent of reducing project document assembly and agency review, and to provide for the highest quality construction methods and materials.
- I. The Specifications are a result of gathering information on the most current and applicable materials and test data available from sources such as ASTM, AWWA, AASHTO, etc. As new materials and techniques become available and acceptable, the Specifications may be revised and upgraded.
- J. These Specifications are written in imperative and abbreviated form. The imperative language is directed at the Contractor, unless specifically noted otherwise. Incomplete sentences shall be completed by inserting “shall”, “the Contractor shall”, “shall be”, and similar mandatory phrases by inference in the same manner as they are applied to notes on the Drawings. The words “shall be:” shall be supplied by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, all indicated requirements shall be performed whether stated imperatively or otherwise.
- K. Questions and comments concerning theses Specifications should be directed to the City Engineer’s Office, 125 W. Mountain St., Fayetteville, Arkansas, 72701 (479) 575-8206.

1.02 DEFINITIONS

- A. City – The City of Fayetteville.
- B. Engineer – The Engineer of record for the Owner or City
- C. Owner – Any Individual, partnership, firm, corporation or other entity who, as property owner, is initiating the work.
- D. Provide – Furnish and install, complete in place, operating, tested and approved.
- E. Products – The materials, systems, and equipment provided by the Contractor.

1.03 SUBMITTALS

- A. Initial submittal for review shall be in PDF format.
- B. Five hard copies, and one PDF copy of submittal documents must be sent to the Engineer.
- C. **The Engineer of Record shall submit permitted submittal documents to the City of Fayetteville before releasing them to the contractor. Legible scanned copies will be permitted for review. The City of Fayetteville reserves the right to make corrections as necessary to ensure compliance with these specifications.**
- D. Construction procedures other than those outlined in these specifications shall be submitted for approval of the City of Fayetteville.
- E. Complete specifications covering any unusual or special construction procedures shall be submitted for approval and approval must be received prior to beginning any construction operations.
- F. A minimum review time of two (2) weeks shall be required on all submittals.

1.04 MAINTENANCE BOND

- A. Once the City accepts the project for ownership, the Owner shall be responsible for the provision to the City of a two (2) year maintenance bond for 50 percent of the construction cost of water lines and sewer lines, which shall cover defects in materials and workmanship. A walk-through shall be performed at the end of the two year period and all deficiencies corrected prior to release of the bond. City maintenance shall begin after expiration of the Two (2) year Maintenance Bond.
- B. If installation of water lines and sewer lines is in conjunction with a development project that includes other public works improvements such as streets, drainage, etc., then the maintenance bond shall be supplied for a period of two (2) years at the percentage of construction as outlined in the current City Ordinance.

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END OF SECTION 1000

SECTION 1100

GENERAL DESIGN STANDARDS - WATER

PART 1 – GENERAL

- A. Construction permits shall be obtained from the City Engineer's Office for the installation of all water facilities connecting to Fayetteville Water System in accordance with the City Ordinance. Water lines shall be designed and installed in accordance with the Standard Specifications for Design and Construction of Water Lines and Sewer Lines.

1.01 PROTECTION OF EXISTING WATER SYSTEM

- A. Only authorized personnel from the City of Fayetteville Water & Sewer Department are permitted to operate valves on the existing water system. **Under no circumstance shall the Contractor operate any valve on the existing water system.**

1.02 WATER LINE MATERIALS

- A. Materials for water line mains up to and including 12-inch shall be PVC.
- B. Ductile iron pipe shall be used for all fire lines, fire hydrant connections, and all pipe greater than 12-inches in diameter.
- C. All buried iron pipe, valves, and fittings shall be double poly wrapped in accordance with these specifications.

1.03 REQUIREMENTS TO EXTEND WATER SERVICE

- A. All new development of any kind shall be required to extend water services to that development at the owner's expense. Water lines shall be extended to each property to be served by City of Fayetteville water. This includes all new developments, infill projects, and lot splits. Water service shall include providing adequate domestic water flows as well as fire protection with hydrants spaced in accordance with the local and state fire codes.
- B. Water service lines shall extend perpendicular to the water main and extended to the property being served where an appropriately sized water meter will be installed.
- C. On subdivision or large scale development water systems, water lines shall be extended through all the development to the property line so that future development(s) can tie on without disrupting the service to or property of any existing customers or owners. Dead end lines shall be avoided whenever possible.

- D. All water lines with dead ends shall be installed with an upstream valve, one full joint of ductile iron pipe with a MJ restraining gland, concrete anchor collar, a MJ cap with restraint, and a blow off assembly. The seat of the MJ restraining gland on the ductile iron pipe shall face the valve.
- E. Developments shall tie to the existing water system at a minimum of two locations to maintain water quality and maintain water service in the event of a water line break in the immediately vicinity. An inline valve shall be installed on the existing water line between the two points of connection if one is not currently installed. Water line extensions shall be required off the development to loop with the existing water distribution system. Construction of such extensions shall be at the expense of the developer.
- F. At other locations easements may be required to facilitate future extension of lines to adjacent properties.
- G. The requirements to extend water service and provide lines adequate for both domestic and fire demands shall apply to all subdivisions regardless of whether they are inside the City Limits or not. Where subdivisions are outside the City Limits, the placement of fire hydrants shall be optional and in no case shall hydrants be installed outside the City unless a) a fire flow of at least 500 gallons per minute can be obtained at the hydrant, and b) the residents being served by the hydrant have a contract for fire protection with the City of Fayetteville and/or with a Washington County Rural Fire Department having a mutual aid agreement with the Fayetteville Fire Department.

1.04 MINIMUM SIZE OF WATER LINES

- A. The minimum sized line that may be installed in the water system is eight (8) inch. This is required even if the line is being extended from an existing line that is smaller than six (6) inches. Two (2) inch lines may be approved for cul-de-sacs provided the line could not be reasonably extended in the future to provide service to adjacent property and where a larger line is not needed to provide either fire protection or adequate domestic flows. Refer to Paragraph 1.21 – Fire Hydrant Spacing and Placement.
- B. The minimum line size requirement for the provision of fire protection shall be a looped 8-inch line or, in the event of a dead end line, an 8-inch. This minimum requirement shall apply regardless of the theoretical flow capacities existing in the system. Lines larger than 8-inch may be required if they are needed to provide domestic and fire flow demands for a development.
- C. The latest Water System Study has recommended a twelve (12) inch water line grid not to exceed a spacing of 1/2 of a mile in both the north-south and east-west direction. In the event that the maximum size water line for a development is eight (8) inches, the City may participate in “cost sharing” for the installation of twelve (12) inch water lines as recommended by the latest Water System Study. The extent of the “cost share” will be for material differences only between 8-inch and 12-inch piping, fittings, and valves. Refer to Paragraph 1.08 – City Participation in Water Line Costs.

1.05 WATER SERVICE LINES

- A. **Water service connections shall be made on 12-inch and smaller water lines.**
- B. Service lines serving single meter sets and double meter sets shall be 1-inch HDPE tubing in accordance with these specifications.
- C. In areas where it is determined by the City Engineer that installation of irrigation systems is likely, service lines that cross roads and serve double meter sets shall be 2" services ending in a 2" x 1" x 1" x 1" splitter. The middle leg of the splitter shall feed the double meter set, with the other two legs containing a ball valve, and being intended to serve future irrigation meters. The meter box shall be no greater than two feet from the splitter.
- D. Service lines serving 1-1/2 inch and 2-inch meter sets shall be 2-inch HDPE tubing in accordance with these specifications.
- E. **Water services lines installed across city streets shall be encased back of curb to back of curb, or state highway right-of-way to right-of-way.** 1-inch lines shall be encased in 1-1/2 inch HDPE SDR9 tubing. 2-inch lines shall be encased in 3-inch HDPE SDR9 tubing.
- F. Service lines serving 3-inch and large meter sets shall be PVC in accordance with these specifications.

1.06 WATER METER SIZE

- A. Water meters serving flows up to 10 gpm continuous (15 gpm intermittent) shall be 5/8" water meter.
- B. Facilities that use flush valve style (tankless) toilets shall use a minimum 1" water meter.
- C. Water meters serving flows up to 25 gpm continuous (40 gpm intermittent) shall be 1" water meter.
- D. Water meters serving flows greater than 25 gpm continuous shall be approved by the City of Fayetteville Meter Department during the plan review process.
 - 1. For reference only, meter flow ranges may be as follows:

a.	1-1/2" meter	up to 65 gpm continuous (100 gpm intermittent)
b.	2" meter	up to 150 gpm continuous (200 gpm intermittent)
c.	3" meter	up to 350 gpm continuous (500 gpm intermittent)
d.	4" meter	up to 800 gpm continuous (1000 gpm intermittent)

1.07 BACKFLOW PREVENTION

- A. The City of Fayetteville water distribution system shall be protected from the possibility of backflow by the use of a reduced-pressure principal backflow prevention assembly (RP), a double check valve assembly (DC), or an air gap in accordance with the Arkansas State Plumbing Code (ASPC), latest edition.
- B. The City of Fayetteville Water & Sewer Department shall review and sign off on all proposed backflow prevention installations.
- C. The following is a partial list of facilities which ordinarily will require a reduced-pressure principal backflow prevention assembly (RP) or an air gap in accordance with the ASPC, latest edition. Requirements are based upon the degree of hazard afforded the public potable water system.
 - 1. Automatic car washes.
 - 2. Auxiliary water systems (interconnected with the public water system).
 - 3. Exterminators and veterinary clinics.
 - 4. Facilities with boilers, condenser water or chilled water systems.
 - 5. Fire systems containing chemical additives.
 - 6. Hospitals, medical clinics, dental clinics, health clinics, sanitariums, morgues, mortuaries, autopsy facilities, nursing and convalescent homes.
 - 7. Irrigation systems and lawn sprinkler systems.
 - 8. Laboratories (industrial, commercial, photography, medical and school.)
 - 9. Commercial laundries.
 - 10. Radiator and battery shops.
 - 11. Restricted, classified or other facilities closed to inspection.
 - 12. Sand, gravel and concrete plants.
 - 13. Wastewater treatment plants, pump stations and storm water pumping facilities.
 - 14. Commercial swimming pools.
 - 15. Commercial farms using pesticides and herbicides.
 - 16. Establishments holding livestock for sale or slaughter including cattle, horses, hogs, poultry, emus, ostriches, llamas, rabbits, etc.
 - 17. Others (with suspected high hazards).
- D. The following is a partial list of facilities which ordinarily will require a minimum of DC or an air gap in accordance with the ASPC, latest edition:
 - 1. Tall buildings (over four stories) or any buildings with water booster pumps.
 - 2. Beauty parlors and barber shops.
 - 3. Hotels and motels.
 - 4. Restaurants, cafeterias, fast-food marts and other food handling facilities.
 - 5. Fire sprinkler systems (without chemicals).
 - 6. Others (with suspected medium hazards).

1.08 WATER SYSTEM STUDY

- A. The City's latest Water System Study shall be the primary basis for decisions made in regard to required line sizes, water line locations, location of water pump stations, water tank sizes and location, and any other matter relating to the water distribution system.
- B. The City Engineer shall have the discretion to alter these requirements.

1.09 CITY PARTICIPATION IN WATER LINE COSTS

- A. In cases where the City desires to have a larger sized water line in place than is required under Paragraph 1.03 of these Specifications, the City may enter into an agreement with the developer to provide for the construction of the larger sized line.
- B. In that event, the City shall be responsible for the difference in material costs only between the size line required for the developer and the size line desired by the City. The City shall not be responsible for any engineering cost associated with the up-sizing unless the larger size line is more than 12-inches in diameter. The City shall not participate in the cost of an 8-inch or smaller line, except that the City may consider participating in the cost of smaller lines when a small number of customers are involved in a non-development situation.
- C. The cost involved in up-sizing shall be determined by the developer's engineer by the taking of bids, and shall be approved by the City Engineer and by the City Council.

1.10 EASEMENTS

- A. For water lines that are up to 10 feet deep, easements shall be at least 20 feet in width with the water line in the center of the easement. For water lines that are greater than 10 feet deep, easements shall be 1 foot per foot of depth to the bottom of the pipe on each side of the water line. The easement may be designated specifically for water line purposes or it may be a general utility easement.
- B. Lines sized 12-inches through 18-inches shall not be placed in easements of less than 25 feet. Lines larger than 18-inches shall be placed in an easement of no less than 30 feet. Wider easements may be required, depending on the specific circumstances involved.
- C. New developments that contain existing water lines must modify the existing easements as necessary to meet the above requirements for widths in relation to pipe location and size, including increasing the size of the easement if proposed fill will cause the depth of bury to exceed ten feet.
- D. Easements of a lesser width will be considered when adjacent to another easement or under other special circumstances.

1.11 PERMITS

- A. All permits required to accomplish the work shall be the responsibility of the owner or engineer. Such permits may include but are not limited to permits for work within Highway Department R/W, railroad crossing permits, "Notice of Intent" for Erosion Control (Arkansas Department of Environmental Quality) Drainage Permit, Grading Permit, and a "No Charge" tapping permit for fire service lines. Work shall not be started without the appropriate permit(s) in place.

1.12 APPROVAL OF WATER EXTENSION PLANS

- A. Detailed plans and specifications shall be required for all extensions and shall be prepared by a professional engineer registered to do business in the State of Arkansas.
- B. The plans and specifications shall be first approved by the City Engineer and then shall be forwarded to the Arkansas Department of Health by the Engineer of Record for their approval. In no case shall any water line construction be allowed before the City has written approval from the Arkansas Department of Health.
- C. Private lines constructed for fire prevention purposes which have no metering device or backflow prevention device at the point of tie-in to the City main shall be treated as a public line and be subject to these specifications as far as engineering, construction techniques, materials, testing, and inspections are concerned. After a final inspection and acceptance of the work, the line shall be owned and maintained by the owner of the property it serves.
- D. No construction of any kind may begin without an erosion control plan on file with the City in accordance with the City's Excavation and Grading Ordinance. The erosion control measures (straw bales, silt dams, silt ponds, etc.) must be in place in the field prior to construction. For projects that require a permit, it is the responsibility of the contractor to have on file with the Arkansas Department of Environmental Quality a "Notice of Intent".
- E. Written notice of the intent to begin construction must be given to the City no less than three (3) days nor more than ten (10) days prior to the construction start date. A pre-construction conference involving the Engineer of Record, Contractor, and the City is required prior to beginning construction.

1.13 LOCATION OF WATER LINES

- A. Water lines shall be placed on public streets either in the right of way or in an easement adjacent to the street right of way except that lines can go between lots when there is no other reasonable way to access a line or provide for future service. **In no case shall lines intended for individual services be placed in the rear of lots or along back property lines.**

- B. Water lines shall be located a minimum of 36-inches from any other parallel utilities or structures.

1.14 LOCATION OF WATER METERS

- A. Water meters shall be located in non-paved areas and readily accessible to the Meter Department without going through fences or gates.
- B. Water meters shall be free of obstructions for a minimum of a 3-foot radius from the center of the water meter box.
- C. Water meters shall be located on the Owner's side of the property line (edge of easement or right-of-way).
- D. Double meter sets shall be located on the common property line between the two properties being served.

1.15 VALVE MARKERS

- A. In all rural settings except those in cleaned yards, when valve boxes, bends, air release valves, blow-offs, meter boxes and other similar hardware are installed in an easement location, water system marker signs shall be installed so that the items may be more easily found.

1.16 WATER LINE DEPTH

- A. Minimum depth to the top of pipe for all water main lines shall be 3.0 feet.
- B. Minimum depth to the top of pipe for water lines 18-inches and greater shall be 4.0 feet.
- C. Maximum water line cover shall be 5.0 feet under normal conditions. Cover greater than 5.0 feet shall be allowed for short distances where required by field conditions and approved by the City.
- D. Minimum depth of all water service lines from the main to the water meter shall be 30-inches.

1.17 WATER PRESSURE

- A. The water distribution system shall be designed to maintain a minimum working water pressure of 45 psi at the water meter.
- B. Design of new construction that results in less than 45 psi working pressure at the water meter shall be approved by the City Engineer on a case by case basis.
- C. Under no circumstances shall the working pressure of the water distribution system be below 20 psi.

1.18 VELOCITIES

- A. Velocities in the water distribution system shall be sized such that velocities will be no greater than five (5) feet per second during normal operation conditions.
- B. Velocities during fire flow conditions shall not exceed ten (10) feet per second.

1.19 VALVES

- A. Valves for 2-inch through 12-inch water distribution shall be resilient seat gate valves.
- B. Valves 14-inch and larger shall be butterfly valves.
- C. Valve spacing in the water distribution system shall not exceed 500 feet in commercial areas, or more than one block or 800 feet in all other areas.
- D. Valves at “tees” shall be such that a valve is located immediately adjacent to each leg of the “tee.”
- E. Valves shall be located on each side of a major stream crossing along with leak detection.

1.20 90 DEGREE BENDS

- A. Ninety degree (90°) bends shall only be used on a by-exception basis, and must each be specifically approved by the City. Forty-five degree (45°) bends separated by a twenty-four (24) inch swivel adapter shall be used in locations where 90° bends would otherwise be considered.

1.21 FIRE FLOW DESIGN

- A. Fire flow design for single family dwellings and duplexes shall be 1,500 gpm for a duration of two (2) hours.
- B. Fire flow design for apartment complexes, commercial structures, and industrial structures shall be as outlined the International Fire Code, latest edition.

1.22 FIRE HYDRANT SPACING AND PLACEMENT

- A. Fire hydrants for single family dwellings and duplexes shall be installed so that (1) the distance between two consecutive fire hydrants does not exceed 500 feet, and (2) no lot is more than 250 feet from a fire hydrant.
- B. Fire hydrants in areas for apartment complexes, commercial structures, and industrial structures shall be installed so that the distance between two consecutive fire hydrants does not exceed 400 feet. The Fire Chief shall have the authority to require additional fire hydrants upon a determination that such additional fire hydrants are necessary to provide adequate fire protection as outlined in the International Fire Code, latest edition.

- C. Fire hydrants shall be free of obstructions for a minimum of a 3-foot radius from the center of the fire hydrant. **Fire hydrants shall be placed outside of any fence.**

1.23 FIRE LINES

- A. Fire lines, backflow prevention, and FDC shall be installed and inspected the same as water lines.
- B. Fire lines shall be constructed of ductile iron pipe and shall be double poly wrapped.
- C. All valves on fire lines shall have the word “FIRE” on the valve box lid.
- D. All valves for fire lines shall have the word “FIRE” on the valve box lid, this includes the valve on the water main. Post indicator valves shall be installed on all fire lines to demarcate ownership. Post indicator valves shall match the valve manufacturer.

1.24 AIR RELEASE VALVES

- A. Air release valves shall be required on uphill, dead-end lines or on other specific applications to protect the water distribution system at the discretion of the City Engineer or Water/Sewer Maintenance Superintendent.

1.25 STEEL ENCASEMENTS

- A. Water lines under culverts, creeks, concrete channels, retaining walls, or other difficult and/or dangerous to maintain areas shall be encased in a smooth steel encasement pipe. The steel encasement shall extend 5 feet either side of the area.
- B. Water lines through steel encasement shall be installed with three spacers per joint such that the spacers are equally spaced along the length of the pipe.
- C. Self-restraining gaskets (DIP only) or bell restraints shall be used for all joints inside the encasement pipe and for the first joint in each direction outside the encasement pipe.
- D. End Seals shall be used on all encasement pipes.
- E. Ductile iron water pipe shall be used in situations where fittings other than a “tee” are required on either side of the steel encasement to change direction or overcome varying field conditions. Additional joint restraints and the use of anchor collars shall be required as directed by the City.

1.26 PLANNED WATER OUTAGES

- A. Under no circumstances shall water be shut off to any active service in the course of new construction without written permission from the City of Fayetteville Water & Sewer Department. If water pressure needs to be reduced to facilitate construction, a preconstruction meeting shall be held. The work shall be performed as described in Section 4200 – Water Line Pressure Reduction Procedures.

1.27 PROTECTION OF WATER SUPPLIES

- A. There shall be no physical connections between a public or private water supply system and a sanitary sewer or appurtenances thereto which would permit the passage of any polluted water into the potable supply. Sanitary sewers shall be laid at least ten (10) feet horizontally from any existing or proposed water line. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten (10) foot separation, the appropriate reviewing agency may allow deviation on a case-by-case basis if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to a water main provided that the water main is in a separate trench or on an undisturbed earth shelf located to one side of the sewer, and at an elevation so the bottom of the water main is at least 18-inches above the top of the sewer.
- B. Sewer lines installed under a water line must have a clear distance between pipes of at least eighteen (18) inches.
- C. The sewer line shall be installed such that a joint of pipe is centered along the water line and the joints are as far as possible from the water line.
- D. If 18-inches of clearance cannot be provided or when the water main must pass under the sewer main, either the sanitary sewer main or the water main shall be encased in twenty (20) feet of watertight encasement pipe, centered over the point of crossing. Crossings that are not perpendicular will require more than twenty (20) feet of encasement. The encasement shall extend a minimum of ten (10) feet perpendicular from the outside edges of the line that is not being encased. The ends of the encasement pipe shall be sealed watertight. Refer to Section 3400 – Steel Encasement Pipe for end seals.

1.28 EXISTING UTILITY STRUCTURES AND FACILITIES

- A. The drawings shall show the location of overhead and underground utility lines and existing water and sewer lines according to the best information presented and available. Drawings shall be submitted to the utilities and shall have indicated to the best of their records the locations of their facilities and the route of the proposed water line.

1.29 UTILITY COORDINATION

- A. It is the responsibility of the Owner or his authorized representative to coordinate with and get approval from the various UTILITIES, including other Departments of the City.

Further, it is the responsibility of the Owner to get authorization to encroach upon any other utilities' easement(s) and secure such recorded encroachment as a requirement for dedication of the water system.

1.30 DRAFTING STANDARDS

A. GENERAL

These standards have been established for the purpose of ensuring uniformity in the design and drafting techniques of projects to be submitted for review and acceptance.

1. All projects submitted shall have a title sheet which shall include:
 - a. General overall area map;
 - b. Vicinity location map;
 - c. A site plan map detailing the project;
 - d. Name/title of project including section number if applicable;
 - e. Owner and Engineer's name; and
 - f. Professional Engineer's seal and signature.
2. All plan and profile sheets are to be certified and dated by a professional engineer of the State of Arkansas.
3. All sheets are to be numbered, with total number of sheets included; i.e., sheet 4 of 12.
4. Include detail sheet(s)/specification sheet(s), as applicable.
5. Design drawings shall be 22-inch by 36-inch, or 24-inch by 36-inch.

B. SCALES

The following scales for drawings are required:

1. Plan and profile: variable; not to exceed

1" = 50' horizontal
1" = 10' vertical
2. Cross sections: 1" = 10' horizontal and vertical.

C. LETTERING

Minimum sizes for lettering shall be:

1. Titles: 1/4" or larger.
2. General: 1/8" or larger.

D. MATERIALS

High quality bonded paper shall be used for all originals and reproduction "originals" to be submitted as record drawings. Any drawing deemed not usable by the City Engineer will be rejected.

E. ORIENTATION

Drawings shall be situated so that north is either toward the top or toward the right side of the sheet. The north arrow shall be clearly visible.

F. PLAN AND PROFILE DRAWINGS

All plan sheets shall include the following information when applicable:

1. A north arrow;
2. The scales used;
3. Project name and number, sheet number, date drawn, date and nature of revisions;
4. All topography in the area affected by construction;
5. Right-of-way lines, property lines and easements;
6. Locations of benchmarks and their descriptions;
7. Locations of all existing and proposed utilities in the project area; and
8. Match lines shall be easily identifiable.

All profiles shall include the following:

1. Existing and finished grade lines;
2. Size and type of pipe;
3. Elevations to USGS datum;
4. Profile of existing and proposed utilities; and
5. Special construction required due to unfavorable soil conditions.

G. USE OF STANDARD SYMBOLS AND NOTATIONS

1. Water plans shall be prepared using standard symbols and notations commonly used in the practice of civil engineering. If necessary, legends shall be provided to define the symbols used.
2. At a minimum the following symbols shall be used:
 - a. FH – Fire Hydrant
 - b. WM – Water Meter
 - c. GV – Gate Valve
 - d. BFV – Butterfly Valve
 - e. WV – Water Valve (unknown type)
 - f. WL-x – Water Line where x identifies diameter in inches
 - g. SS-x – Sewer Line where x identifies diameter in inches
 - h. FL-x – Fire Lines where x identifies diameter in inches

1.31 RECORD DRAWINGS

A. DATUM REQUIREMENTS

1. Horizontal Datum: NAD83 (1986) Arkansas State Plane, North Zone, US foot (Grid System).
2. Vertical Datum: NAVD88 (feet)

B. TOLERANCES

1. Horizontal: +/- 0.5 feet
2. Vertical: +/- 0.05 feet

C. Water drawings submitted as record ("as-built") drawings shall indicate the location where the water line was installed and have the following items surveyed during/after construction and shown on the drawings:

1. Fire hydrant, location and top operating nut elevation
2. Water valves, location
3. Water fittings, location
4. Water service saddle, location
5. Water service saddles used for testing, location
6. Water meters, location
7. Tapping sleeves, location
8. Any other pipe penetrations, location
9. Steel encasements, location
10. Details shall be provided for all vertical offset water lines, profile drawing

D. Manufacturing data shall be collected for pipe, valves, and hydrants as follows:

1. Pipe
 - a. Manufacturer
 - b. Material (DI or PVC)
 - c. Diameter
 - d. Production run code or lot code
2. Valves
 - a. Manufacturer
 - b. Model number
 - c. Year manufactured
 - d. Type (gate, butterfly, ball)
 - e. Diameter
3. Hydrants
 - a. Manufacturer
 - b. Model number
 - c. Year manufactured
 - d. Depth of bury, including extensions

- E. All sheets shall have the phrase "as-built" or "record drawing" boldly printed on them with the as constructed date, and shall be stamped and signed by a professional engineer registered in the State of Arkansas. Record drawings shall be submitted in hard copy, .dwg electronic format, and .pdf electronic format.

1.32 INSPECTIONS AND TESTING PROCEDURES

- A. All field tests required for a project shall be witnessed by the City in the presence of the Engineer of Record or his authorized representative and the Contractor. The City representative shall be one of the Public Works Construction Inspectors.
- B. The City requires a 24 hour working day notice on all tests. Calls to the City for the purpose of setting test times shall be made by no later than 10:00 AM for test on the following work day.
- C. Tests delayed by weather or other factors will be rescheduled on the same basis. If a test cannot be reasonably scheduled so that a representative of the City can be present, the Engineer of Record will witness the test and certify to the City the results.
- D. In no case shall a test be made without the presence of the Engineer of Record and the Contractor. It is the responsibility of the Engineer of Record and/or the Contractor to coordinate the scheduling of tests with the City and with the other parties involved.
- E. The tests generally associated with water line construction are:
 - 1. Pressure testing of tapping sleeve installations
 - 2. Pressure testing of lines after installation
 - 3. Disinfection
 - 4. Bacteriological (Bac-T) testing
 - 5. Fire hydrant flow testing
 - 6. Trace wire continuity testing
- F. Generally, no Contractor or Engineer of Record involvement is required in the taking of samples for the Bac-T test except that the Contractor is responsible for the proper flushing of the line prior to samples being taken by the City. However, the City may require the presence of the Contractor or Engineer of Record when questions have been raised as to the methodology or techniques used in the sampling process.
- G. Bac-T samples are sent to the State Department of Health for testing. Results obtained by the City shall be forwarded to the Engineer of Record either by email, fax, or mail upon receipt by the City.
- H. Lines failing the Bac-T tests shall be re-sampled as soon as practicable. If a line fails two (2) consecutive Bac-T tests, the line must be re-chlorinated before Bac-T samples can be taken again. The City shall not be responsible for rescheduling Bac-T tests.

- I. The fire hydrant test shall consist of checking the operation of the fire hydrant valve and flowing the fire hydrant. This shall be done after the pressure test has been completed. The fire hydrant valve shall be left in the open position during the test and after the test is completed.
- J. All equipment, materials, and labor required for testing shall be furnished by the Contractor at his expense.

1.33 FINAL ACCEPTANCE BY THE CITY

- A. The City will be deemed to have accepted water lines and appurtenances for ownership upon completion of the following.
 - 1. Acceptable Final Inspection by the following:
 - a. A representative of the City Engineer's Office
 - b. A representative of the Fayetteville Water and Sewer Department
 - c. The Engineer of Record
 - d. The Contractor
 - 2. Acceptable walk-through by the Meter Foreman for location, grade, and condition of water meter settings
 - 3. Construction Cost is received by the City
 - 4. Two sets of Record Drawings are received by the City
 - 5. Engineer of Record Certification is received by the City
 - 6. Letter of Acceptance is granted by the City
- B. No water meter shall be set until all final acceptance requirements are met and the line is accepted in writing by the City.

1.34 APPLICABILITY

- A. These regulations and requirements contained in these Standard Specifications shall be applicable to all land or parcels of land being developed for commercial, industrial, or residential use. The material and construction specifications shall be applicable to all water line construction under the control of the City of Fayetteville.

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END OF SECTION 1100

SECTION 1200

GENERAL DESIGN STANDARDS - SEWER

PART 1 – GENERAL

- A. Construction permits shall be obtained from the City Engineer's Office for the installation of all sanitary sewer facilities discharging into the Fayetteville Sanitary Sewer System in accordance with the City Ordinance. Sanitary sewer facilities shall be designed and installed in accordance with the Standard Specifications for Design and Construction of Water Lines and Sewer Lines.

1.01 REQUIREMENTS TO EXTEND SEWER SERVICE

- A. All new development of any kind shall be required to extend sewer services to that development at the owner's expense. Sewer lines shall be extended to each property to be served by City of Fayetteville sewer. This includes all new developments, infill projects, and lot splits.
- B. Sewer service lines shall extend perpendicular to the sewer main and extended to the property being served.

1.02 DESIGN CRITERIA

A. GENERAL

All sanitary sewers shall be designed to carry the estimated flow from the area ultimately contributing to the respective reach of the sanitary sewer. The required capacity shall either be established by the City or at the City's option by means of a basin study developed by the Owner or his authorized engineer/designer. In no instance shall a gravity sewer, other than a building sewer, be less than eight (8) inches in diameter.

The following design standards for gravity sewers within or contributing to the City of Fayetteville Sanitary Sewer System have been established:

1. Population Density

Population density shall be in accordance with the Comprehensive Plan for Fayetteville projected by the Division of Planning for the City of Fayetteville or actual count or character of proposed development, whichever is greatest.

2. Average Family

For the purposes of design the average family unit is considered to be 3.0 persons per single family home.

3. Design Flow

The design of all sanitary sewer facilities shall be based on future area population growth and land development characteristics and figures provided by the Department of Planning including the servicing of existing contiguous developed areas not currently served by sanitary sewers. The values of Average and Peak Flow and Design Population hereby shall be the values which include the future flows and population. The City reserves the right to review and determine the appropriateness and/or applicability of the estimated flow volumes provided.

The following shall be used as a guide:

a. Average Design Flows

- 1) Single Family Residential: The average design flow for single family dwellings shall be one hundred (100) gallons per person per day.
- 2) Commercial/Industrial/Institutional: Based upon information either submitted by the Owner or developed by the City. These flow volume guidelines may be modified at the City's discretion.

b. Peak Design Flow

- 1) Single Family Residential: The peak design flow for a single family development shall be calculated as follows:

$$Peak\ Flow = (Avg.\ Flow) \left[\frac{18 + \sqrt{P}}{4 + \sqrt{P}} \right]$$

Where P is equal to the total Design Population in thousands.

- 2) Commercial/Industrial/Institutional: The peak design flow from commercial, industrial or institutional developments shall be the average daily flow determined multiplied by 2.5. **The peak design flow shall not be less than 90% of the peak water demand or exceed the flow limits of the water meter supplying the facility.**

4. Design Capacities: Collector and trunk sewers shall be designed on the following basis:

a. Collector Sewers Twelve (12) Inches and Smaller

Peak design flow capacities shall be based on sewers flowing two-thirds (2/3) full.

b. Trunk Sewers Fifteen (15) Inches and Larger

Peak design flow capacities for trunk or interceptor sewers shall be based on sewers flowing 90% full, without head, using the design population density and appropriate land use determined by the Division of Planning; and shall include an allowance for infiltration which will be reviewed on a case-by-case basis and is subject to the approval of the City.

1.03 MINIMUM PIPE SIZES AND STANDARDS

A. PIPE DIAMETER

1. The required diameter of gravity sewers shall be determined by Manning's formula using a roughness coefficient, "n" of 0.013 or the pipe manufacturer's recommendation, whichever is greater. The minimum pipe diameter for gravity sewers lines shall be eight (8) inches.

B. MINIMUM SLOPES AND VELOCITIES

1. All sanitary collector and trunk sewers shall be designed and constructed to provide a minimum velocity when flowing full of two (2) feet per second. The slope of the sewer pipe shall be such that these minimum velocity requirements are attained. The minimum acceptable slopes for the design and construction of sanitary sewers are as follows:
2. THESE ARE MINIMUM SLOPES REQUIRED OF THE DESIGN. AS CONSTRUCTED SANITARY SEWERS FOUND TO HAVE LESS THAN THIS MINIMUM SLOPE SHALL NOT BE ACCEPTED.

Pipe Size* (inches)	Minimum Slope (Feet per 100 Feet, %)
8	0.50
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24 and greater	0.08

*4" and 6" lines are allowed for building sewers only. For details see UPC (Uniform Plumbing Code), latest edition.

C. MINIMUM DEPTH

1. For the protection of the sanitary sewer lines from damage caused by utilities installed after the sanitary sewer has been constructed, the minimum depth to crown of all gravity sanitary sewers shall be 3.0 feet, and the minimum depth to crown of all force main sanitary sewers shall be 3.0 feet.

D. BUILDING SEWERS

1. Building sewers shall conform to the latest edition of the Uniform Plumbing Code and to these Standards.
2. The building sewer shall connect to the public sewer at a mainline fitting. **Sewer service connections shall be made on 12-inch and smaller sewer lines.** Connections to manholes shall only be allowed at upstream terminating manholes or by approval of the City. Inside drop connections to manholes are not allowed.
3. Building sewers requiring a 6-inch or larger sewer connection shall be connected at a manhole. If an existing manhole is not available, a new manhole must be constructed.
4. Homes or buildings where the lowest elevation to have gravity sewer service is less than 1 foot above the cover of either the first upstream or downstream manhole on the sewer main shall have a cleanout with a pop-up type, non-locking cover at an elevation no less than 6-inches below the lowest sanitary facility in the structure.
5. Homes or buildings with a slope from the lowest sanitary facility to the public sewer main less than 1 percent shall be served with a pump system. The system shall be purchased, installed, and maintained by the owner.
6. Building sewers within the right-of-way or easement shall be a minimum of four (4) inches in diameter. Building sewers shall have a wye cleanout located within three (3) feet of the building's exterior wall and extended to 3-inches above grade and shall have a watertight, removable cap.
7. Cleanouts installed under concrete or asphalt paving shall be made accessible by a short bodied cast iron valve box.
8. Building sewers installed for future connections shall be terminated at the right-of-way or easement and plugged to ensure 100 percent water tightness. Mark wyes for future connections using marking tape, tracer wire, yellow nylon rope, and 1/2" x 4' rebar or fence tee-post.

1.04 SEWER LINE MATERIALS

- A. Materials for sewer line mains shall be PVC unless approved by the City of Fayetteville or otherwise indicated in these specifications.

1.05 LOCATION OF SEWER LINES

- A. Sewer lines shall be placed on public streets either in the right of way or in an easement adjacent to the street right of way except that lines can go between lots when there is no other reasonable way to access a line or provide for future service. Sewer lines located in easements behind houses without a dedicated, paved alley shall have the manholes located adjacent to the nearest street right-of-way.
- B. Sewer lines shall be located a minimum of 36-inches from any other parallel utilities or structures.

1.06 SEWER STRUCTURES

A. MANHOLES

1. General

- a. Manholes shall be installed at the end of each line; at all changes in grade, size, materials or alignment; at all sewer intersections and at the following intervals:

Pipe Diameter (inches)	Maximum Interval Between Manholes (feet)
8 to 18	400
21 and larger	500

- b. Manholes shall be located such that they are readily accessible to sewer cleaning equipment. Access shall be a minimum 10' wide all weather drive surface. 10' wide double gates shall be provided for all fences where manhole access is required. Sewer mains located in easements behind houses without a dedicated, paved alley shall have the manholes located adjacent to the nearest street right-of-way.
- c. The minimum inside diameter of manholes shall be as stated in Section 3300-Manholes.
- d. Flow channels shall be shaped and formed in each manhole to provide a smooth transition of flow from all inlets to the outlet. The bench wall shall be formed from the center of the manhole to the outlet pipe in the shape of a "U" as shown in the Standard Details.
- e. At changes in sewer alignment and/or sizes, the energy gradient elevation shall not increase. This shall be accomplished by keeping the crown elevation continuous where possible for changes in sewer sizes.

- f. Connections to manholes on trunk sewer lines shall be installed at such elevations that will not cause a backup in the collector sewer. Trunk sewers are designed to flow completely full during peak operation. Therefore, connections should not be made below the crown of the trunk sewer line pipe.
- g. Minimum drop across the manhole from inlet invert to outlet invert for size on size pipes shall be 0.10' for 0 up to 45 degree change in direction, and 0.20' for 45 to 90 degree change in direction.
- h. Manholes proposed to be installed in unpaved areas shall be designed and constructed such that the top of the casting is a minimum of three (3) inches and a maximum of five (5) inches above the finished grade to prevent ponding of water over the casting. Positive drainage away from the manhole shall be provided.
- i. Manholes constructed within a 100-yr floodplain shall be constructed such that the rim elevation is a minimum of 2-feet above the flood elevation or be constructed with hinged and gasketed covers. Manholes that are within the 100-yr floodplain and also within the ROW shall have hinged and gasketed covers.
- j. **Manholes located on 15-inch and larger sewer lines or manholes on sewer lines within 100 feet of a 15-inch and larger sewer line shall be epoxy coated on the interior.**

2. Outside Drop Connections

- a. Outside drop pipe connections shall be provided for all sanitary sewers entering a manhole at an elevation greater than twenty-four (24) inches above the invert of the manhole.
- b. In areas where future residential, commercial, and/or industrial growth can occur, all new manholes 15 feet deep or deeper shall be equipped with up to two (2) outside drop connections of a size and at an elevation to be determined by the City at the time of design to allow for future connections at these points. The drops shall extend from the base to within 10 feet of the final graded surface elevation.

NOTE: THIS SHOULD NOT IMPLY THAT EVERY MANHOLE SHALL BE PROVIDED WITH 2 OUTSIDE DROP CONNECTIONS.

B. SEWER PUMP STATIONS

- 1. **A construction permit shall not be issued for a sanitary sewer pump station until an economic analysis proves to the satisfaction of the City that the pump station exhibits a lower 20-year life cycle cost than extending a gravity sewer to the development.**

2. The analysis shall be per latest standard practice for least cost (life cycle) as developed by ASTM C1131 and evaluate labor costs, maintenance costs (including parts replacements), operation costs and rehabilitation costs. The analysis shall take into consideration both interest and inflation rates.
3. The following minimum assumptions shall be made when calculating life cycle costs.
 - a. Pump Station Construction Costs = Actual cost
 - b. SCADA System = \$7,500
 - c. Pump Station Routine O&M labor = 50 hrs/year @ \$40/hr
 - d. Effective Energy Costs = \$0.25/kW·hr
 - e. Interest Rate = 5%
 - f. Inflation Rate = 3%
 - g. Replace pumps in year 11
4. In the event that a pump station is more cost effective than gravity sewer, the operation and maintenance expenses for the pump station must be paid in addition to the monthly sewer service charges paid by the benefiting customers. The Developer must pay, **in advance**, the present value of the estimated operation and maintenance costs for the estimated service life of the pump station. The estimated service life shall be 20 years.
5. If a pump station is more cost effective, the City of Fayetteville reserves the right to cost share with the developer to pay for a gravity sewer extension in lieu of a pump station.

1.07 EASEMENTS AND DEEDS

A. GENERAL

1. Whenever possible, sanitary sewers shall be constructed within the public right-of-way. Should the construction be outside the limits of the public right-of-way, recorded sewer easements shall be acquired, dedicated and recorded solely for the benefit of the City. Easement boundaries shall be so shown on the plans and specifications as "Water and Sewer Easement" in lieu of "Utility Easement". Sanitary sewers may be constructed within "platted" utility easements if the work is performed in conjunction with a development approved by the City.
2. The minimum permanent easement widths to be dedicated to the City are as follows:

<u>Depth of Sewer from Finished Grade</u>	<u>Easement (ft)</u>
up to 10 feet	20
> 10 feet to 20 feet	25
greater than 20 feet	30

3. All sanitary sewers shall be centered in the easement. For those sanitary sewers constructed in the public right-of-way, the easement shall extend the distance outside the right-of-way necessary to provide the required easement width. Sewers not centered in the easements shall have an easement width equal to 1/2 that designated above on each side of the easement.
4. A minimum 50 foot by 50 foot deeded property shall be provided for all submersible lift stations with wet wells up to 20 feet deep. Deeds for lift stations with wet wells greater than 20 foot deep and/or wet well/dry pit lift stations shall be handled on a case by case basis.
5. The sewer easements shall be exclusively under the discretion and control of the City. Ingress and egress shall be available to the City's crews at all times. No utility companies are allowed to use the sewer easements for installation of their utility lines without the expressed written permission of the City. All plan sheets shall clearly identify the sanitary sewer easement and the location of all other proposed utilities. The horizontal and vertical plans shall identify all utilities proposed to cross the sanitary sewer easement.

1.08 DRAFTING STANDARDS

A. GENERAL

These standards have been established for the purpose of ensuring uniformity in the design and drafting techniques of projects to be submitted for review and acceptance.

1. All projects submitted shall have a title sheet which shall include:
 - a. General overall area map;
 - b. Vicinity location map;
 - c. A site plan map detailing the project;
 - d. Name/title of project including section number if applicable;
 - e. Owner and Engineer's name; and
 - f. Professional Engineer's seal and signature.
2. All plan and profile sheets are to be certified and dated by a professional engineer of the State of Arkansas.
3. All sheets are to be numbered, with total number of sheets included; i.e., sheet 4 of 12.
4. Include detail sheet(s)/specification sheet(s), as applicable.
5. Design drawings shall be 22-inch by 36-inch, or 24-inch by 36-inch.

B. SCALES

The following scales for drawings are required:

1. Plan and profile: variable; not to exceed
1" = 50' horizontal
1" = 10' vertical
2. Cross sections: 1" = 10' horizontal and vertical.

C. LETTERING

Minimum sizes for lettering shall be:

1. Titles: 1/4" or larger.
2. General: 1/8" or larger.

D. MATERIALS

1. High quality bonded paper shall be used for all originals and reproduction "originals" to be submitted as record drawings. Any drawing deemed not usable by the City Engineer will be rejected.

E. ORIENTATION

1. Drawings shall be situated so that north is either toward the top or toward the right side of the sheet. The north arrow shall be clearly visible.

F. PLAN AND PROFILE DRAWINGS

All plan sheets shall include the following information when applicable:

1. A north arrow;
2. The scales used;
3. Project name and number, sheet number, date drawn, date and nature of revisions;
4. All topography in the area affected by construction;
5. Right-of-way lines, property lines and easements;
6. Locations of benchmarks and their descriptions;
7. Locations of all existing and proposed utilities in the project area; and
8. Match lines shall be easily identifiable.

All profiles shall include the following:

1. Existing and finished grade lines;
2. Inverts at all manholes;

3. Length and size of pipe between manholes;
4. Slope of pipe in percent;
5. Elevations to USGS datum;
6. Top of casting elevations;
7. Types of materials used;
8. Profile of existing and proposed utilities; and
9. Special construction required due to unfavorable soil conditions.

G. SEWER PUMP STATION DRAWINGS

Sewer pump station drawings shall, at a minimum, contain the following:

1. At least two views of the station, plan view and cross section;
2. Electrical panel detail;
3. All electrical designs shall be sealed by a licensed electrical engineer;
4. Pump and alarm control elevations;
5. Inlet and outlet pipe elevations;
6. Finished grade and foundation elevations;
7. Special construction required due to unfavorable soil conditions;
8. Design pump capacity, rated horsepower, total dynamic head, manufacturer and model number;
9. Wetwell capacity and cycle time;
10. Also, the Engineer shall submit a copy of the head discharge curve and the complete design calculations for the lift station and force main; and
11. Fence and access drive detail.

H. USE OF STANDARD SYMBOLS AND NOTATIONS

1. Sanitary sewer plans shall be prepared using standard symbols and notations commonly used in the practice of civil engineering. If necessary, legends shall be provided to define the symbols used.

1.09 RECORD DRAWINGS

A. DATUM REQUIREMENTS

1. Horizontal Datum: NAD83 (1986) Arkansas State Plane, North Zone, US foot (Grid System).
2. Vertical Datum: NAVD88 (feet)

B. TOLERANCES

1. Horizontal: +/- 0.5 feet
2. Vertical: +/- 0.05 feet

- C. Sanitary sewer drawings submitted as record ("as-built") drawings shall indicate the location where the sewer line was installed and have the following items surveyed during/after construction and shown on the drawings:
1. Manholes, location and rim elevation
 2. Pipe material, diameter, and invert elevations
 3. Sewer main percent slope (calculated and setting from pipe laser)
 4. Lateral connections. Lateral measurements shall be indicated by their distance from the downstream manhole in the form of stationing. Lateral stationing shall begin at 0+00 at each downstream manhole.
 5. Location of capped service lines
 6. Cleanouts (if installed during construction)
 7. Location of fittings, valves, and valve boxes on force mains
 8. Location of steel encasements
 9. TV video (DVD format) and logs shall be delivered to the City of Fayetteville. Video shall play in a standard DVD player without the need of viewing software.
- D. All sheets shall have the phrase "as-built" or "record drawing" boldly printed on them with the as constructed date, and shall be stamped and signed by a professional engineer registered in the State of Arkansas. Record drawings shall be submitted in hard copy, .dwg electronic format, and .pdf electronic format.

1.10 PROTECTION OF WATER SUPPLIES

- A. There shall be no physical connections between a public or private water supply system and a sanitary sewer or appurtenances thereto which would permit the passage of any polluted water into the potable supply. Sanitary sewers shall be laid at least ten (10) feet horizontally from any existing or proposed water line. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten (10) foot separation, the appropriate reviewing agency may allow deviation on a case-by-case basis if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to a water main provided that the water main is in a separate trench or on an undisturbed earth shelf located to one side of the sewer, and at an elevation so the bottom of the water main is at least 18-inches above the top of the sewer.
- B. Sewer lines installed under a water line must have a clear distance between pipes of at least eighteen (18) inches.
- C. The sewer line shall be installed such that a joint of pipe is centered along the water line and the joints are as far as possible from the water line.
- D. If 18-inches of clearance cannot be provided or when the water main must pass under the sewer main, either the sanitary sewer main or the water main shall be encased in twenty (20) feet of watertight encasement pipe, centered over the point of crossing. Crossings that are not perpendicular will require more than twenty (20) feet of encasement. The encasement shall extend a minimum of ten (10) feet perpendicular from the outside edges of the line that is not being encased. The ends of the encasement pipe shall be sealed watertight. Refer to Section 3400 – Steel Encasement Pipe.

1.11 EXISTING UTILITY STRUCTURES AND FACILITIES

- A. The drawings shall show the location of overhead and underground utility lines and existing sewers according to the best information presented and available. Drawings shall be submitted to the utilities and shall have indicated to the best of their records the locations of their facilities and the route of the proposed sewer.

1.12 UTILITY COORDINATION

- A. It is the responsibility of the Owner or his authorized representative to coordinate with and get approval from the various UTILITIES, including other Departments of the City. Further, it is the responsibility of the Owner to get authorization to encroach upon any other utilities' easement(s) and secure such recorded encroachment as a requirement for dedication of the sanitary sewer system.

1.13 STEEL ENCASEMENTS

- A. Sanitary sewers shall be encased in steel encasement pipe wherever the sanitary sewer crosses under, through, or over a drainage way (i.e. creeks, rivers, streams, concrete channels, concrete storm drains, or any storm drain 30-inch diameter and larger, or all storm drains with multiple pipe runs). Wherever applicable, the sanitary sewer crossing the drainage way shall be pressure tested to assure 100 percent water tightness prior to backfilling.
- B. Sewer lines through steel encasement shall be installed with three spacers per joint such that the spacers are equally spaced along the length of the pipe.
- C. Self-restraining gaskets (DIP only) or bell restraints shall be used for all joints inside the encasement pipe and for the first joint in each direction outside the encasement pipe.
- D. End Seals shall be used on all encasement pipes.

SOME WASTEWATER FLOWS*

Type of Establishment*		Gallons Per Person of Wastewater Per Day Unless Otherwise Noted
1.	Institutions other than hospitals	180 - 120
2.	Schools (without gym and showers)	15
3.	Schools (with gyms and showers)	25
4.	Organization camps only	
	a. With showers and handwashing facilities	20 +
	b. With toilets, showers and handwashing facilities	40 +
	+ Cooking or central food service included.	
5.	Campgrounds	
	a. With individual sewer connections (per site)	100
	b. With community building only (per site)	50
6.	Mobile home parks (per mobile home park space)	200
7.	Motels and hotels (per room)	100
8.	Restaurants along an interstate or major highway; 24-hour operation (per seat)	70
9.	Restaurants; 24-hour operation (per seat)	50
10.	Restaurants; less than 24-hour operation (per seat)	35
11.	Bars and cocktail lounges (per seat)	35
12.	Bowling alleys (per alley)	100
13.	Places of employment (does not include industrial waste, per employee per shift)	15-35
14.	Day workers at offices	15
15.	Picnic parks and areas	5
16.	Drive-in theaters (per ramp parking space)	7
17.	Service stations (per vehicle served)	10

Type of Establishment*		Gallons Per Person of Wastewater Per Day Unless Otherwise Noted
18.	Swimming pool bathhouse (per person)	10
19.	Private dwelling (per dwelling)	300
20.	Apartments	
	a. One bedroom (per apartment)	200
	b. Two bedroom or more (per bedroom)	150
21.	Shopping center (where stores are not known) per square foot building area	0.45
22.	Churches	
	a. Without kitchen (per sanctuary seat)	3
	b. With kitchen (per sanctuary seat)	5
23.	Beauty salon	35
24.	Day care center	20

* The flows listed indicate a reasonable approach for the type of establishment referred to. Additional considerations will be necessary in some cases.

For uses not mentioned in this table, flow estimates should be submitted for preliminary design review and possible approval prior to proceeding with final plans.

END OF SECTION 1200

SECTION 2000

TRENCH SAFETY

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The Contractor is responsible for ensuring that safe working conditions exist and safety procedures are being followed at the work site. The Contractor is responsible to notify OSHA of the commencement of all water or sewer construction.
- B. If the Contractor is working for any public body (state agency, county, municipality, school district, or other local tax unit or improvement district), they shall be responsible for notifying the Arkansas Department of Labor Safety Division, (501) 682-9091 when water or sewer construction jobs are to begin. A copy of a letter or reporting form shall be sent to the City of Fayetteville Engineering Division.
- C. Regarding Trench Safety Systems, the Contractor shall design, install, and maintain a "Trench Safety System" in strict compliance with OSHA (Occupational Safety and Health Administration) Part 1926 of the Code of Federal Regulations and all other applicable federal, state, and local requirements.

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END OF SECTION 2000

SECTION 2100

EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall accomplish temporary and permanent erosion protection related to grubbing, grading, excavation, paving, and other work as directed by the Engineer and as shown on the approved drawings. An erosion control plan shall be submitted to the Engineer prior to the commencement of construction.
- B. The Contractor is responsible for implementing Best Management Practices (BMPs) during construction activities, (including, but not limited to, sediment and erosion control structures) and achievement of final stabilization upon completion of construction activities.
- C. The Contractor shall be responsible for implementing all applicable requirements of the ADEQ General Stormwater Permit for Construction Activity, the Spill Prevention Control and Countermeasures Plan (SPCCP), as required by USEPA, local Municipal Separate Storm Sewer requirements, and all other environmental regulatory requirements that are associated with the construction activities that they are contracted to perform. The Contractor is responsible for managing all materials, equipment, and activities at the work site in a manner that is in compliance with local, State, and Federal environmental regulations.

PART 2 – PRODUCTS

- A. Not used

PART 3 – EXECUTION

3.01 TEMPORARY EROSION CONTROL

- A. The Contractor shall construct temporary berms, dikes, dams, ditching or sediment basins, and maintain such control features until permanent erosion control features are placed all in accordance with the City or State "Erosion Control Standards".

3.02 SILT FENCES

- A. Silt Fences: In areas where silt fencing is required, Contractor shall use the following installation specifications:
1. Posts for silt fences shall be 2-inch diameter pine, 2-inch diameter oak, or 1.33-lb/linear ft. steel with a minimum length of 3 feet.
 2. Contractor shall use silt fence geotextile fabric specifications, in accordance with Section 625 of the Arkansas 2003 Standard Specifications for Highway Construction: Type 3 or Type 4. Only those fabric types specified for use as silt fence by the manufacturer shall be used.
 3. Filter fabric shall be stretched and securely fastened to the fence with wire fasteners, staples, or preformed clips.
 4. Fabric shall be attached to “upgradient” side of posts to prevent stormwater flow from tearing fabric from posts.
 5. All silt fences shall be installed at level grade following contours. Both ends of each fence section shall be extended at least 8 feet upslope at 45 degrees to the main fence alignment to allow for pooling of water and prevent stormwater runoff from flowing around end of silt fence.
 6. Ends of a silt fence shall be tied into the landscape to prevent flow around the end of the fence before the pool reaches design level. Contractor shall provide stabilized outlets to protect the fence system and release storm flows that exceed the design storm. At fabric ends, both ends shall be overlapped a minimum of 6 inches, folded, and secured to the fence. The fabric toe should be placed in the bottom of the trench, backfilled, and compacted.
 7. Contractor shall be responsible for maintenance of silt fences. Silt accumulations shall be removed before they reach 1/3 of the silt fence height. Silt fences shall be replaced, as necessary, should they fail to achieve adequate sedimentation control.
 8. Contractor shall ensure that the depth of impounded water does not exceed 1.5 feet at any point along the silt fence.
 9. The design life of a synthetic silt fence should be approximately 6 months.

10. The slope length is the distance from the fence to the drainage divide or the nearest upslope channel. The maximum slope length above silt fence shall not exceed the following dimensions:

Slope – Percent	Maximum Slope Length (ft) Above Fence	
	18-Inch High Fence	30-Inch High Fence
2 (or Less)	150	500
5	100	250
10	50	150
15	35	100
20	25	70
25	20	55
30	15	45
35	15	40
40	15	35
45	10	30
50	10	25

11. “Super” silt fence with chain-link fencing or 2-inch by 4-inch wire backing shall be used to control runoff from small disturbed areas where the maximum slope lengths for standard 18-inch or 30-inch silt fence cannot be met and sufficient room for construction of sediment traps or basins does not exist.
12. “Super” silt fence shall not be used in areas where rock or rocky soils prevent the full and uniform anchoring of the fence or proper installation of the fence posts. It shall be used only where access exists or can be made for the construction equipment required to install and remove the fencing.
13. Wire reinforcement for “super” silt fence shall be a minimum 14 gauge and a maximum mesh spacing of 4 inches.
14. The maximum slope length above any “super” silt fence should not exceed the following dimensions:

Slope Percent	Maximum Slope Length (ft)
2 (or less)	1,000
5	500
10	300
20	200
30	100
40	75
50	50

15. Poles for “super” silt fence shall be 2.5-inch diameter galvanized or aluminum posts, or 4 feet long steel “T-posts”, set at 6-feet maximum spacing. Poles

shall be driven a minimum 18 inches below the ground surface and extend a minimum of 30 inches above the ground surface.

16. The “super” silt fence shall be entrenched into an 8-inch deep trench and the disturbance on the downslope side shall be minimized. The bottom of the trench should be at level grade. Maximum deviation from level grade should be 5 percent, and not extend for more than 50 feet, where practicable.
17. “Super” silt fence shall be installed at level grade. Both ends of each fence section shall be extended at least 8 feet upslope at 45 degrees to the main fence alignment to allow for pooling of water.
18. Silt fence shall be installed so as to serve a 10-year peak storm event. A 10-year, 24-hour peak storm event equates to approximately 5 inches of rainfall, resulting in 2.3 inches to 4.9 inches of runoff.
19. Silt accumulations shall be removed before they reach 1/3 of the silt fence height.

3.03 STRAW BALE CHECK DAMS

- A. According to the EPA BMP Manual, the use of hay bales in concentrated flow areas is not recommended as a best management practice.
- B. Contractor shall use straw bale check dams only where the following conditions apply:
 1. Where contributing area is approximately 1/2 acre, or less.
 2. Where there is not concentration of water in a channel above the barrier.
 3. Where length of slope above the barrier is less than 100 feet.
 4. Where straw bales are used in conjunction with silt fence.
- C. Straw bales shall not be used on high silt producing areas, above high-risk areas, where water concentrates, or where there would be a possibility of a washout.
- D. Straw bales shall not be used in excess of a three-month time period. If construction continues beyond this time period, the existing straw bales shall be replaced with new bales.

- E. Contractor shall install straw bales to the following specifications:
1. Anchors shall be No. 5 reinforcing bars, 2 inch x 2 inch oak stakes, or steel pickets.
 2. A trench shall be excavated along the areas where straw bales will be used to a depth of 4 inches and to the width of one straw bale. The straw bales then shall be placed in the trench with excavated material placed on upgradient side of the check dam and compacted.
 3. Straw bales shall be anchored with a minimum of 2 stakes or rebars per bale, driven into the underlying soil, making sure that the binding wire or twine is facing the sides and not touching the soil. The first stake into each bale shall be driven toward the previously laid bale to force them together.
 4. Spacing between the bales shall be tightly chinked with loose straw and overlapped with an additional straw bale.
 5. Ends of a check dam shall be angled outward and upgradient to prevent flow around the end of the check dam before the pool reaches design level.
 6. After straw bales are in place the excavated soil shall be backfilled against the upslope side of the straw bales to a height of 4 inches after compacting.
 7. Straw bales shall be routinely inspected to determine if any repairs or replacements to the straw bales are needed. If it is determined that the straw bales need to be repaired or replaced, the work will occur immediately. Silt accumulations shall be removed before they reach 1/3 the barrier height.

3.04 WATTLES

- A. Wattles are a sediment and stormwater velocity control device. They are tubes of straw, rice straw, or coconut husk encased in ultraviolet (UV) degradable plastic netting or 100% biodegradable burlap material. Wattles help stabilize slopes by breaking up the length, and by slowing and spreading overland water flow.
- B. Wattles may be suitable along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow; at the end of a downward slope where it transitions to a steeper slope; along sidewalks and curbs to prevent sediment from washing into gutters; around storm drains and drop inlets; down-slope of exposed soil areas; and around temporary material spoil and stockpiles, such as topsoil and for streambank (sensitive area) protection.

C. Contractor shall install wattles to the following specifications:

1. Installation of wattles begins by constructing a shallow trench, 2 to 4 inches deep, and shaped to accept the wattle, along the contour of the slope. All debris (rocks and clods) that would prevent close contact between the wattle and soil should be removed. The wattle is placed in the trench, and excavated material from the trench is packed tightly along the base of the wattle, on the uphill side. The wattle should be secured with 1-inch by 1-inch wooden stakes. The stakes should be placed at a 4-foot spacing and driven in perpendicular to the slope through the center of the wattle leaving less than 2 inches of stake exposed above the wattle. The terminating ends of each wattle installation should be turned uphill a minimum of 6 inches to prevent runoff from flowing around the ends of the wattle.
2. Flat ground application. Install along sidewalks and behind curbs, fitting tightly against the concrete before backfilling, then backfill the wattle to create a trench.
3. Storm drain inlet protection. Wattles placed along the back of curb should be offset, as required to go around structures such as curb intakes that project behind the back of curb. At these locations, the wattle should be placed behind the structure (not over it) and shaped to direct water around either side of the structure to prevent ponding. At area intake locations, a shallow trench should be constructed 1 to 2 feet away from the edge of the intake. The wattle should be placed in the trench and firmly staked in place.
4. Slope application. Wattles should be installed on the contour from the bottom of the slope upward.
5. Materials. Wattles can be made from straw, rice straw, coconut husk, or other approved material. The netting consists of biodegradable burlap or ultraviolet (UV) degradable plastic netting. Straw should be Certified Weed Free Forage, by a manufacturer whose principle business is wattle manufacturing. Coir (coconut fiber) can be in bristle and mattress form, and should be obtained from freshwater cured coconut husk.
6. Application. Wattles are available in a variety of diameters ranging from 9 inches to 20 inches. The most common sizes are 9 and 12-inch wattles. The allowable spacing for these diameters shall be, as follows:

Slope	Spacing Intervals (ft)	
	9" Diameter	12" Diameter
<4:1	20	40
2:1 to 4:1	15	30
2:1 or greater	10	20

7. For soft, loamy soils, the spacing interval should be decreased. For hard, rocky soils, the spacing interval may be increased.
8. For highly erosive soils, and for slopes 2:1 or greater, an additional row of wooden stakes should be provided on the downhill side of the wattle.
9. Maintenance. Repair or replace split, torn, unraveling or slumping wattles. If the wattle is used as a sediment capture device, or as an erosion control device to maintain sheet flows, sediment that accumulates in the wattle must be periodically removed when accumulation reaches one-half the designated sediment storage depth, usually one-half the distance between the top of the fiber roll and the adjacent ground in order to maintain effectiveness. If wattles are used for reduction of slope length, sediment removal should not be required as long as the system continues to control the grade. Additional sediment control practices are required to be used in conjunction with this type of application.

3.05 PIT/TRENCH DEWATERING

- A. Water removed from open pits and/or trenches shall have silt removed prior to leaving the immediate site of construction. Silt shall be removed by natural vegetation, a straw bale trench dewatering inlet device, settling pond, filter bag, a rock/geotextile fabric sediment trap/basin, or other appropriate sediment control measure. Water filtered through a basin shall not violate any water quality standard and shall have efficient sediment/silt removal prior to discharging to a waterbody.
- B. Contractor shall be responsible for providing adequate number of pumps for prompt and efficient dewatering. Ends of discharge hoses shall be provided with flow dispersion and filtration devices to prevent scouring of surface soils, discharge of turbid water, and/or washout of stream banks. Discharges from dewatering activities shall not be conveyed into or upon any roadside ditch, curb and gutter, street or publicly used thoroughfare.
- C. The direct discharge of silty/muddy water to a stream is strictly prohibited.
- D. The direct discharge of silty/muddy water off of the project site is strictly prohibited.
- E. The direct discharge across areas of equipment access points and/or construction haul roads is strictly prohibited.
- F. Contractor is solely responsible for adequate maintenance of dewatering filtration and sedimentation structures to assure they are working in an efficient manner.

3.06 OTHER CONTROLS

- A. A dedicated concrete truck wash out area shall be maintained to include adequate containment to prevent runoff of concrete truck wash water. Concrete truck drivers shall be notified to use wash out area.
- B. Contractor shall follow the appropriate waste storage and disposal practices, as per applicable environmental regulatory requirements. Solid waste dumpsters/roll-offs, or other appropriate waste receptacles will be maintained and used at the site. Good housekeeping practices will preclude trash, construction wastes, and debris to be dumped or scattered on the construction site. There shall be no open burning of any waste material. No solid materials, including building materials, shall be discharged to waters of the State.
- C. No liquid waste chemicals, fuels, and/or oils are to be leaked or spilled on ground surfaces. Bulk storage of liquid chemical wastes will be provided with secondary containment with a capacity sufficient to contain the volume of the largest container within the secondary containment. All waste materials shall be stored in a manner to prevent releases and should be disposed of by a qualified waste disposal firm at an acceptable waste disposal facility. Records of the disposal of all solid, hazardous, non-hazardous, and liquid wastes are to be maintained by the Contractor. Contractor shall notify the Engineer of any spills or leaks that occur in spite of the preventive measures taken. Contractor will prepare a report of any spills or leaks in accordance with the reporting and recordkeeping measures described in the BMPs. No contaminants from fuel storage areas, hazardous waste storage and truck wash areas shall be discharged to waters of the State. These areas should not be located near a water body, if there is a water body on or near the project.
- D. Contractor shall maintain compliance with applicable State and/or local sanitary sewer, septic system, and waste disposal regulations.
- E. Used and/or waste oil generated from equipment maintenance is exempt from the hazardous waste rules, as long as it is transported offsite to be recycled/reused. Contractor shall be responsible for disposal of waste oils, fuels, and fluids at a recycling/reuse facility and shall provide written documentation of the final waste disposal method and facility location, including EPA identification number of transporter and disposal facility to the Engineer.
- F. Off-site vehicle tracking of sediments and the generation of dust must be minimized. Measures such as stone at construction access points, parking areas, and unpaved roads that carry significant amounts of traffic (e.g. more than 25 vehicles per day), providing entrance wash racks or stations for trucks, and/or street sweeping shall be implemented where appropriate. Application of water to construction haul roads should be done, as appropriate, to control dust generation. Application of excessive levels of water that create mud should be avoided.

3.07 PERMANENT EROSION CONTROL

- A. The Contractor shall incorporate permanent erosion control features into the project at the earliest practicable time as the construction progresses all in accordance with the City or State "Erosion Control Standards", and the following as necessary:

1. EROSION CONTROL FABRIC

- a. The fabrics shall act to block the force of rain and act as a mulch.
- b. The mat shall be clean and weed free using biodegradable materials that will not leave a residue.
- c. The application of the specific seed, lime, and fertilizer shall be applied immediately before laying the fabric.
- d. The fabric shall be laid according to the manufacturer's recommendations and as approved by the City.

2. RIPRAP

- a. Riprap shall be placed where indicated on the approved plans and in accordance with the State of Arkansas Highway Standards.
- b. The type of riprap required shall be indicated on the Drawings and as directed and approved by the City.
- c. Non-woven filter fabric shall be placed beneath the riprap as shown on the Drawings. Filter fabric shall be a minimum of 12 oz/sy by weight.

3. SEED/SOD

- a. Seed mixtures and mulched seeding shall be placed as early as practicable to keep the area of bare soil exposed at any one time by construction operations to a minimum.
- b. Sod shall be placed as shown on the approved Drawings and as directed by the City.
- c. Seed and sod shall be placed according to Section 6100.

4. GABIONS (STONE FILLED)

- a. Gabion materials shall be non-corrosive, high strength polyethylene, or galvanized steel.

- b. Stone fill material shall be placed in the gabion by hand. The stone shall be hard durable rock not less than three (3) inches.
- c. The gabion shall be constructed, installed, and filled as recommended by the manufacturer and as directed by the City.

3.08 APPROVED ALTERNATIVES

- A. The Contractor may use alternate permanent erosion control protection methods only with written authorization from the City.

END OF SECTION 2100

SECTION 2200

SITE PREPARATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Excavation, grading, cutting and removal of trees, shrubs and underbrush, and the removal of any debris existing above natural ground surface and within the cleared area necessary to permit the construction of the improvements.

1.02 RELATED WORK

- A. Section 3000 – Sewer Pipe, Fittings, and Materials
- B. Section 3100 – Installation of Sewer Pipe, Fittings, and Materials
- C. Section 3200 – Installation of Sewer Service Lines
- D. Section 3300 – Manholes
- E. Section 3400 – Steel Encasement Pipe
- F. Section 4000 – Water Pipe, Fittings, and Materials
- G. Section 4100 – Installation of Water Pipe, Fittings, and Materials

1.03 PROTECTION

- A. In all cases the Contractor is responsible for protecting public and private property: and, protecting any person or persons who might be injured as a result of the Contractor's work.
- B. All utilities shown on the plans may not represent the exact location: however, the Contractor is responsible for verifying these locations and contacting the Arkansas One Call System before excavating.

PART 2 - MATERIALS

- A. Not used

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor will be required to submit a plan to build access roads/trails for approval by the Engineer.
- B. It shall be the responsibility of each bidder to examine the site carefully and make his own calculations as to costs to be incurred by reason of the requirements of this section.
- C. Trees, shrubs, underbrush and debris removed from the improvement right of way shall be disposed of by the Contractor in a manner approved by the City.

3.02 SITE PREPARATION

- A. Clear areas necessary for performance of the work and confine operations to that area provided through easements, licenses, agreements and rights-of-way. Entrance upon any lands outside of that area provided by easements, licenses, agreements or public rights-of-way, shall be at the Contractor's sole liability.
- B. Do not occupy any portion of the project site prior to the date established in the Notice to Proceed without prior approval of the Owner.
- C. Contractor shall be aware of certain requirements by individual property owners as stipulated in easement documents pertaining to the project.
- D. Remove, relocate, reconstruct or work around natural obstructions, existing facilities and improvements encountered during site preparation as herein specified. Take care while performing site preparation work adjacent to facilities intended to remain in place. Promptly repair damage to existing facilities. Dispose of waste materials in a satisfactory manner off the work site.
- E. Protect, move, or brace public and private utilities as required by the affected utility.
- F. Maintain mailboxes in the manner that the Postal Service requires to prevent interruption of mail delivery.
- G. Site preparation includes the removal of trees, shrubs, brush, crops, and other vegetation within the limits of the easements (right-of-way), or as may be provided for in licenses, permits and agreements. All efforts shall be made to retain existing landscaping. In the event that trees, shrubbery, and hedges cannot be saved, then prior approval of the Owner and the Owner's Representative must be obtained before the existing landscaping is removed.

1. Trees

- a. All trees shall be saved unless removal is approved by the City and the Inspector. Trim trees in accordance with the City's instructions.

2. Shrubbery

- a. Shrubbery shall be saved unless removal is approved by the City and the Owner's Representative. Make reasonable efforts to save all shrubbery by trimming, in accordance with acceptable pruning practices, and treating wound surfaces with a commercial pruning compound.

3. Small Plants and Flowers

- a. At least two weeks prior to the start of construction, notify property owners of the proposed starting date so that the property owners can remove any small plants or flowers.

4. Protection of Existing Facilities

- a. The Contractor shall notify all property owners in the immediate vicinity of the construction area that may be affected by the construction activities a minimum of 24-hours before starting work in that area. The notification shall include a description of the work, work hours, and a 24-hour contact name and number for the contractor.
- b. Fences interfering with construction, and located within public rights-of-way or as may be allowed for in permits or agreements, may be removed only if the opening is provided with a temporary gate which will be maintained in a closed position except to permit passage of equipment and vehicles, unless otherwise herein specified. Fences within temporary construction easements may be removed provided that temporary fencing is installed in such a manner as to serve the purpose of the fencing removed.
- c. Fencing removed shall be restored to the condition existing prior to construction unless otherwise specified. The Contractor is solely liable for the straying of any animals protected or corralled or other damage caused by any fence so removed.
- d. Driveways and driveway approaches removed or damaged during construction shall be restored to the original condition or better condition prior to construction.

- e. Make every reasonable effort to protect private sewer facilities. Private sewer facilities may not be shown on the Plans.
- f. Preserve property corners, pins and markers. In the event any property corners, pins, or markers are removed by the Contractor, such property points shall be replaced at the Contractor's expense and shall be re-set by competent surveyors properly licensed to do such work. In the event such points are section corners or Federal land corners, they shall be referenced and filed with the appropriate authority.
- g. Where existing utilities and service lines are encountered, notify the owner thereof at least 48 hours (not including weekends and/or holidays) in advance of performing any work in the vicinity.
- h. Excavate, install pipeline and backfill in the vicinity of such utilities in the manner required by the respective owner and, if requested, under his direct supervision. The Contractor shall be responsible for damages to a public or private utility that may occur as the result of the construction.
- i. Protect, move, or brace public and private utilities as required by the affected utility.
- j. Make a reasonable effort to ascertain the existence of obstructions and locate obstructions by digging in advance of machine excavation where definite information is not available as to their exact location. Where such facilities are unexpectedly encountered and damaged, notify responsible officials and other affected parties and arrange for the prompt repair and restoration of service.

END OF SECTION 2200

SECTION 2300

EXCAVATION, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Excavation, backfilling, and compaction for water lines, sewer lines, appurtenances, and incidental construction.

1.02 RELATED WORK

- A. Section 3000 – Sewer Pipe, Fittings, and Materials
- B. Section 3100 – Installation of Sewer Pipe, Fittings, and Materials
- C. Section 3200 – Installation of Sewer Service Lines
- D. Section 3300 – Manholes
- E. Section 3400 – Steel Encasement Pipe
- F. Section 4000 – Water Pipe, Fittings, and Materials
- G. Section 4100 – Installation of Water Pipe, Fittings, and Materials
- H. Section 6000 - Pavement Repair
- I. Section 6100 - Lawns & Grasses

1.03 QUALITY ASSURANCE

- A. One moisture/density relationship test (AASHTO T-99 with Note 7, or AASHTO T-180 with Note 8) shall be taken at the beginning of the project, and one additional moisture/density relationship test shall be taken for every 5,000 cubic yards of imported material. ASTM testing methods for moisture/density relationships may not be used for embankment and subgrade materials.
- B. Determine the field density of backfill in accordance with AASHTO Designation T-147.
- C. A minimum of one density test per 500 lineal feet of pipe or portion thereof when the pipe is located in the street or under the curb and gutter.

1.04 REFERENCES

- A. Not Used.

1.05 PROTECTION

- A. The Work included in this Project may require excavation and related activities in close proximity to existing buried and aerial utility lines and facilities, such as water lines, sewer lines, storm drains, natural gas lines, electrical power lines, telephone cables, and TV cables. Where their presence is known, the approximate location of such utilities is shown on the Drawings, but all such utilities and individual service lines are not shown. The Contractor shall be aware of the potential for such utility lines to conflict with intended construction efforts, and the Contractor shall use appropriate precautionary measures to locate and protect such utility lines and services so as to avoid damage and interruptions to service.
- B. The Contractor shall contact the owners of the various existing utilities lines and services as may be affected by the construction and solicit their assistance in identifying, locating, marking, and protecting these facilities prior to the beginning of any excavation or other work which might endanger the existing utilities. If such utilities are damaged or impaired because of the Contractor's actions or omissions, the Contractor shall be responsible for the cost of repairs or replacements of the affected or damaged utility or service line.
- C. The Contractor shall comply with the Arkansas One-Call System and shall alert potentially conflicting utility systems accordingly.
- D. In all cases, the Contractor is responsible for protecting public and private property; and, protecting any person or persons who might be injured as a result of the Contractor's work.

1.06 DUST CONTROL

- A. The Contractor shall be responsible for maintaining the site and adjoining paved surfaces in a dust free condition. Fugitive dust control is the sole responsibility of the Contractor.

1.07 SEDIMENT CONTROL

- A. The Contractor shall be responsible for all sediment control in accordance with Section 2100 – Erosion and Sediment Control.

PART 2 - PRODUCTS

2.01 EMBEDMENT MATERIALS - GENERAL

- A. Embedment materials are restricted to materials as described below.
- B. Gravel material for select backfill across streets, roads, driveways, and for placement of "gravel" surfaced areas, shall be Class 7 material conforming to the Standard Specifications of the Arkansas Highway & Transportation Department, latest edition.

2.02 CLASS I EMBEDMENT MATERIAL

- A. Class I embedment material shall be in accordance with ASTM D 2487, latest edition and shall conform to class 1A embedment materials in accordance with ASTM D 2321, latest edition. Material shall meet the grading requirements of ASTM C 33, gradation 67, commonly referred to as ASTM #67 (3/4" concrete aggregate or 5/8" aggregate) or ASTM C 33, gradation 7, commonly referred to as ASTM #7 (1/2" aggregate). Maximum aggregate size shall be 3/4 inch. This includes materials such as crushed stone or rock.

2.03 GRIT EMBEDMENT MATERIAL

- A. Grit embedment material is permitted for the installation of water lines. It is not permitted for the installation of sewer lines. Grit shall be the by-product of rock crushing, generally consisting of 1/4" and smaller limestone material.

2.04 SELECT NATIVE BACKFILL MATERIAL

- A. Select native material shall be good earth, sand, or gravel that is free from large rocks or hard lumpy materials. Never use materials of perishable, frozen, spongy or otherwise unsuitable nature as select material.

2.05 FLOWABLE FILL MATERIAL

- A. Flowable fill material for select backfill across streets, roads, and driveways shall be Flowable Select Material conforming to the Standard Specifications of the Arkansas Highway & Transportation Department, latest edition.

2.06 RIPRAP

- A. Riprap material for bank stabilization and erosion control shall conform to the Standard Specifications of the Arkansas Highway & Transportation Department, latest edition. Riprap shall be designed by an Engineer for the application, including area, size, and depth of placement.

PART 3 - EXECUTION

3.01 EXCAVATION - GENERAL

- A. All excavation shall be carried accurately to the line and grade shown on the Drawings and as established by the Engineer.
- B. When excavation is necessary to be carried below or beyond that which is required, fill the over-excavated space with compacted Class I material, or with concrete as approved by the Engineer.
- C. The Contractor shall use a trench box or provide and install shoring where necessary to protect the labor, the work, or adjacent property. Shoring shall be maintained in place until the backfill has proceeded to a point where it can be safely removed.
- D. Dewater all excavations before any construction is undertaken in accordance with Section 2100 of these specifications.
- E. Install pipe only in dry trenches. Place concrete upon dry, firm foundation material only.

3.02 DISPOSAL OF EXCAVATED MATERIALS

- A. The Contractor shall be responsible for disposal of excess material, or disposal of excavated material unsuitable for backfilling.
- B. Disposal of excess material shall only be allowed on private property with written permission of the owner of the property. A copy of the written permission must be forwarded to the Engineer along with any permits as may be required by the governing authority, city or county. Grading permits are required for any disposal within the City of Fayetteville city limits.

3.03 EXPLOSIVES

- A. Notify the Engineer in advance if the use of explosives is necessary for the efficient execution of the work.
- B. All work pertaining to the use of explosives shall be performed by qualified personnel.
- C. The Contractor shall obtain all the necessary permits from all governmental bodies. Copies of permits must be submitted to the Engineer and the Contractor shall keep a copy of all permits on the job site at all times.
- D. Follow all governing OSHA safety regulations.

- E. Exercise every precaution to prevent damage to adjoining improvements or property.
- F. Always use a blasting shield or mat.
- G. Any damage to private property resulting from the use of explosives is the liability of the Contractor.

3.04 TRENCH DEWATERING

- A. Dewater all trenches, in accordance with Section 2100, to the extent that water or sewer pipe can be placed on a dry and firm trench bottom. Never place pipe in a wet or unstable trench. The allowable dewatering methods are:

- 1. Well pointing; and,
- 2. Over Excavation and Sump Pumping.

Submit for approval other trench dewatering procedures.

- B. Well Pointing Procedure

- 1. Install well points where required to keep the excavation dry and the subgrade stable.
- 2. Install well points when the excavation is within two (2) feet of the water table.
- 3. Provide sufficient pumping equipment, in good working order and available at all times, to remove any water that accumulates in excavations so a stable subgrade is obtained.
- 4. Keep all dewatering equipment in continuous operation until backfill is completed.

- C. Pump, pipe, and drain all water resulting from dewatering operations into a properly designed dewatering structure or device in accordance with Section 2100. Prevent flooding of streets or private property.

- D. Soil that cannot be properly dewatered: excavate and install 2" – 3" rock to provide a firm trench bottom.

- E. Divert surface runoff water away from the excavation. Where the excavation crosses natural drainage channels, care should be taken to prevent unnecessary damage or delays. Route diverted surface water into existing drainage structures,

such as storm sewers, ditches, or streams. Prevent flooding of streets or private property.

- F. Discharge of trench water or surface runoff into a sanitary sewer is a violation of City of Fayetteville Ordinance and violators will be prosecuted as prescribed by law.

3.05 SHEETING AND SHORING

- A. Provide sheeting and shoring of trenches to:
 - 1. Protect the safety of workers;
 - 2. Provide suitable means for constructing the sewer line;
 - 3. To maintain the trench free from slides or cave-ins;
 - 4. And, to protect public or private property, including existing utilities, buildings, streets, or other structures that are close to the trench.
- B. Follow all governing OSHA safety regulations.
- C. Keep shoring in place until the backfill has proceeded to a point where it can safely be removed.

3.06 EXCAVATION –TRENCHES

- A. Trench For Water or Sewer Line - During excavation, all pipe to be replaced shall be removed and disposed of offsite at a suitable landfill. Trench excavation for water or sewer lines shall be kept within the maximum width limits as shown on the Drawings. The specified maximum trench width from the bottom of the trench to 24-inches above the outside top of the pipe shall not be exceeded unless specifically authorized by the Engineer.
- B. Trench For Water or Sewer Line in Paved Area – Prior to excavation in paved areas, the Contractor shall saw-cut (or other acceptable method approved by the Engineer) the existing pavement to minimize the destruction of the existing pavement outside the limits of the trench. The maximum trench width for the installation of water or sewer lines, up to 12-inches in diameter, in paved areas shall not exceed 36-inches without written approval from Engineer. The pavement shall be repaired in accordance with Section 6000 – Pavement Repair. Contractor is responsible for damage to paved areas by construction equipment outside the limits of trench excavation.

- C. Keep the trench widths within the limits specified below. This requirement is to avoid superimposed loading in excess of the designed and specified pipe strength; and to provide sufficient room for proper installation and bedding of water and sewer lines.

Inside Pipe Diameter (Inches)	Maximum Width of Trench From Top of Pipe to <u>2' Above Top of Pipe</u>
6, 8, 10	2' - 6"
12, 14, 15, 16	3' - 0"
18, 21	3' - 6"
24, 30	4' - 0"
36	4' - 6"
42	5' - 0"

- D. If necessary to prevent sliding and caving, cut the trench banks back on a slope above an elevation two (2) feet above the outside top of the pipe to reduce the earth load on the trench sides. Never exceed the specified maximum width until 2 ft. above the outside top of the pipe. See Section 2000 – Trench Safety.
- E. Do not advance trench excavation more than three hundred (300) feet ahead of the completed pipe work and backfill.

3.07 OVER EXCAVATION

- A. Over excavate below the required subgrade only under the conditions as listed below.
1. The soil at the bottom of the trench is mucky or in such condition that it cannot be properly shaped and graded.
 2. The subgrade material is too soft to properly support the pipe.
- B. After over excavating, provide and install a fill consisting of 2" – 3" rock thoroughly tamped into place in a maximum of eight (8) inch lifts up to an elevation sufficient to prepare the subgrade for the particular bedding class required.

3.08 BEDDING AND BACKFILLING - GENERAL

- A. Install all sewer pipe using Class I embedment materials only. Refer to Standard Detail Drawings.
- B. Install all water pipe using Class I embedment materials or grit embedment materials. Refer to Standard Detail Drawings.
- C. It is essential that the complete backfill be done in such a manner to minimize voids in the backfill.

- D. Backfilling includes refilling and consolidating the fill in the excavation up to the surrounding ground surface or road grade.
- E. Use select native materials for backfilling in unpaved areas.
- F. Where trenches are to be located beneath existing or proposed streets, drives, and parking areas, all backfilling procedures shall be in accordance with the Standard Detail Drawings.
- G. Use mechanical compaction devices manufactured for that purpose to compact backfill materials in trenches.
- H. Pipe marking tape shall be provided in all trenches for water or sewer line construction. Installation shall be per manufacturer's recommendations and shall be as close as practical to finished grade while maintaining a required minimum of 18 inches between the marking tape and the top of any pipe line.

3.09 BEDDING AND BACKFILLING PIPE

- A. Bed pipe as described below and in accordance with the standard trench details shown in Standard Detail Drawings. The intent of the bedding is to create a uniform support which will protect the pipe from localized stress points and to provide for a well graded trench bottom.
- B. Provide a minimum cover of thirty-six (36) inches over the top of pipe.
- C. Extend the trench excavation to a minimum depth of six (6) inches below the bottom of the pipe.
- D. Install bedding materials in no greater than eight (8) inch compacted lifts. Install bedding from six (6) inches below the pipe to six (6) inches above the pipe. Shovel slice bedding beneath the pipe haunches. Tracer wire shall be installed six (6) inches above the top of pipe.
- E. Compact all bedding material to a minimum density of 80% standard proctor as outlined in AASHTO T-99.
- F. **The maximum depth of bury for PVC pipe is sixteen (16) feet.** Any depths greater than sixteen (16) feet require ductile iron pipe, unless approved by the City of Fayetteville.
- G. Install pipe in accordance with Section 3100 and Section 4100.
- H. Backfill and compact the excavation.

3.10 EXCAVATION, BACKFILLING AND COMPACTION FOR MISCELLANEOUS STRUCTURES

- A. Excavate a sufficient distance from walls and footings to allow for forms and for proper inspection.
- B. Leave at least (12) inches between the outer surface of miscellaneous structures and the excavation or shoring.

3.11 RIPRAP

- A. The slope shall be properly prepared to receive riprap and shall include all necessary excavation and backfill and the construction of a toe trench if required.
- B. Place riprap as shown on the Drawings or as directed by the Engineer.

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END OF SECTION 2300

SECTION 3000

SEWER PIPE, FITTINGS, AND MATERIALS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the manufacture, transportation, and storage of pipe, pipe joints, and fittings for sanitary sewer pipelines and service lines.
- B. Use only pipe, fittings, and adapters approved by the City of Fayetteville.
- C. Use bends, tees, plugs, wyes, or other approved fittings constructed from the same material as the pipe in which they are installed. Use only standard, approved fittings.

1.02 RELATED WORK

- A. Section 3100 - Sanitary Sewer Pipelines
- B. Section 3200 - Sanitary Sewer Service Lines
- C. Section 3300 - Manholes
- D. Section 5200 - Inspection and Testing of Sanitary Sewer Pipelines, Manholes, and Service Lines

1.03 SUBMITTALS

- A. Use of materials other than those specifically listed below is prohibited.
- B. Submit the manufacturer's certificate that the pipe meets with these Specification requirements including material testing requirements.

1.04 REFERENCES

- A. Not Used.

PART 2 - PRODUCTS

2.01 PROHIBITED PIPE MATERIALS

- A. The following materials are specifically forbidden for use either in city sewers or service lines:
 - 1. Asphalt impregnated fiber tube pipe.
 - 2. Clay pipe.
 - 3. Concrete pipe.
 - 4. Open profile PVC pipe as defined in ASTM F794.
 - 5. “No Hub” cast iron soil pipe or other non bell and spigot pipe.

2.02 SERVICE LINES AND FITTINGS

- A. Service lines are four (4) inches in diameter or larger.
- B. Furnish the following:
 - 1. Polyvinyl chloride (PVC) pipe for service lines shall be SCH 40, glue joints, and shall be completely bedded as required for larger PVC pipe.
- C. Fittings for service lines shall be:
 - 1. SCH 40 PVC with glue joints.

2.03 CLEANOUTS

- A. Cleanouts shall be Two-Way Memphis Code, SCH 40 PVC. The riser pipe shall be topped off with a screw type plug.
- B. Cleanouts installed in asphalt or concrete shall be protected by a cast iron short bodied valve box, Model 70 as manufactured by East Jordan Iron Works.

2.04 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE (Solid Wall)

- A. Pipe fifteen (15) inches in diameter and less: conform to ASTM D 3034. Maximum standard dimension ratio (SDR) shall be twenty six (SDR 26).
- B. Pipe greater than (15) inches in diameter: conform to T-1 as specified in ASTM F 679.
- C. Joint connections: push on, elastomeric gasket type conforming to ASTM D 3212.
- D. Marking: The date of manufacture, class of pipe, specification designation, size of pipe, name or trademark of manufacturer, and identification of plant/location shall be legibly marked on the outside of each pipe section in accordance with the ASTM D-3034.

2.05 POLYETHYLENE ENCASEMENT (PIPE WRAP)

- A. Polyethylene encasement shall be in conformance to ANSI/AWWA C105, latest revision. The virgin linear low-density polyethylene film shall have a minimum normal thickness of .008 inches (8 mils), and shall be provided in either flat tube or sheet form.
- B. The color shall be black with nominal 2% carbon black UV inhibitor and printed per the AWWA C105 standard.
- C. Tape for field taping of polywrapped pipe, fittings, etc. or field repair of missing polyethylene encasement material shall be Polyken #900, Scotchrap #50 or equal, at least 2-inches wide, and installed as per the Polyethylene Encasement Installation Guide published by DIPRA. **Duct Tape is not permitted.**
- D. **All buried iron pipe and fittings shall be double poly wrapped.**

2.06 INTERIOR EPOXY LINING FOR DUCTILE IRON PIPE AND FITTINGS

- A. A 40 mil nominal dry film thickness protective lining shall be provided consisting of an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. The lining material shall be Protecto 401 Ceramic Epoxy or approved equal.
- B. All cut ends shall be immediately repaired with a field epoxy touch-up kit.

2.07 DUCTILE IRON PIPE FOR GRAVITY MAINS

- A. Gravity Sanitary Sewer ASTM A 746: Ductile Iron Pipe Gravity Sewer Pipe
- B. Minimum Pressure Class shall be as follows:
 - 1. 18-inch and smaller 350 psi
 - 2. 24-inch 250 psi
 - 3. 30-inch and greater 200 psi
- C. A 40 mil nominal dry film thickness protective lining shall be provided consisting of an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. The lining material shall be Protecto 401 Ceramic Epoxy or approved equal. All cut ends shall be immediately repaired with a field epoxy touch-up kit.
- D. Joint connections, pipe and fittings:
 - 1. Push on and mechanical rubber gasket joints: ANSI/AWWA C111/A21.11.
 - 2. Flanged: ANSI/AWWA C115/A21.15, ANSI B16.1.
 - 3. Grooved and shouldered ANSI/AWWA C606.

- E. Weights and Marking: Weights of pipe and fittings shall conform strictly to the requirements of ANSI Specifications. The class designations for the various classes of pipe and fittings shall be cast onto fittings in raised numerals, and cast or stamped on the outside of each joint of pipe. Weights shall be plainly and conspicuously painted in white on the outside of each joint of pipe and each fitting after the exterior coating has hardened.
- F. Corrosion Control
 - 1. Polyethylene wrap in tube or sheet form conforming to the requirements of ANSI/AWWA C105/A21.5. The pipe shall be double wrapped.
 - 2. Epoxy Coating Inside

2.08 DUCTILE IRON FITTINGS

- A. All ductile iron fittings shall conform to the requirements of ANSI/AWWA C153/A21.53, latest revision, for Ductile Iron Compact Fittings. **All fittings shall have a ceramic epoxy coating suitable for sewer service, Protecto 401, or equal.**

2.09 CENTRIFUGALLY CAST FIBERGLASS GRAVITY SEWER PIPE

- A. Pipe shall conform to all requirements of ASTM 3262 for fiberglass pipe.
- B. Pipe stiffness shall meet or exceed manufacturer's recommendations. Minimum pipe stiffness shall be 46 psi.
- C. Manufactured by Hobas USA, Inc.

2.10 REINFORCED FLEXIBLE RUBBER COUPLINGS

- A. Materials: Chemical resistant rubber. Flexible rubber coupling shall be Fernco or equal.
- B. Flexible rubber coupling shall be reinforced with a stainless steel shear ring.
- C. Clamping bands: two (2) each stainless steel bands.
- D. Dimensions: Inside diameter to fit the outside diameter of the different pipe materials being connected: take care that proper alignment is maintained and the spacing between pipes does not exceed 1/2 inch as shown in the Standard Detail Drawings.

2.11 SERVICE SADDLES

- A. A composite saddle using a Virgin SBR compound gasket (ASTM D-2000 3 BA715) and a ductile iron saddle casting (ASTM A 536 Grade 65-44-12) as shown in the Standard Details.
- B. All saddles shall be approved by the Engineer prior to installation.

2.12 SERVICE WYES

- A. The wye material and joint type must match that of the mainline pipe.
- B. Wyes shall terminate in a bell suitable for connection of a 4 inch SCH 40 PVC service line pipe as specified herein.

2.13 MECHANICAL JOINT RETAINER GLANDS

- A. Restraint devices for mechanical joint fittings and appurtenances for nominal pipe sizes 3-inch through 48-inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
- B. Mechanical joint retainer glands shall be made from ductile iron and shall be designed for a working pressure of at least 350-psi for 3-inch through 16-inch ductile iron pipe, at least 305-psi for 3-inch through 12-inch PVC, and at least 250-psi for 18-inch through 48-inch ductile iron pipe.
- C. Retainer glands shall have an approved coating system for corrosion resistance equivalent to MEGA-BOND® and manufacturing traceability. Retainer glands shall be manufactured by EBAA Iron, Inc., Smith-Blair, Inc., or Star Pipe Products (USA only).
 - 1. Retainer glands for pipe sizes 3-inch through 12-inch shall be manufactured by EBAA Iron, Inc., Smith-Blair, Inc., or Star Pipe Products (USA only).
 - 2. Retainer glands for pipe sizes greater than 12-inches shall be manufactured by EBAA Iron, Inc., or Star Pipe Products (USA only).

2.14 PIPE RESTRAINTS

- A. Bell restraints for AWWA C900 PVC sizes 4-inch through 12-inch shall be Series 1900 Restraint Harness, as manufactured by EBAA Iron, Inc. Devices shall have an approved coating system for corrosion resistance equivalent to MEGA-BOND® and manufacturing traceability.

- B. Bell restraints for SDR26 PVC sizes 6-inch through 36-inch shall be provided as required. Devices shall have an approved coating system for corrosion resistance equivalent to MEGA-BOND® and manufacturing traceability.
- C. Bell restraints for Ductile Iron Pipe sizes 4-inch through 48-inch shall be Series 1700 Restraint Harness, as manufactured by EBAA Iron, Inc. Devices shall have an approved coating system for corrosion resistance equivalent to MEGA-BOND® and manufacturing traceability.
- D. When all-thread attachments are required, **eye-bolt style attachments are not acceptable**. Romac “Ductile Lug” style attachments or approved equal shall be used. All-threads shall be made of 316 stainless steel.

2.15 BOLTS

- A. All bolts for valves, fittings, and restraints shall be 316 stainless steel. **Anti-seize lubricant shall be used when assembling all stainless steel hardware to reduce galling.**

2.16 FORCE MAIN MATERIALS

- A. Each material acceptable for force main construction is described below. **The Engineer shall submit a design fatigue analysis to determine which material will be used.**
- B. The City may require that force main be constructed in such a fashion that they may be converted to gravity sewer lines at a later date with the only modification to be adding manholes.

2.17 POLYVINYL CHLORIDE (PVC) PIPE FOR FORCE MAINS

- A. PVC pipe less than 4 inches in size shall be manufactured in accordance with ASTM D-2241 and be SDR 13.5.
- B. PVC pipe 4 inches through 12 inches in size shall be manufactured in accordance with AWWA C900, latest revision, and shall be DR 14.
- C. PVC pipe, couplings, and fabricated fittings shall be made from virgin PVC resin that has been compounded to provide physical and chemical properties that equal or exceed cell class 12454 as defined in ASTM D1784, latest revision. Clean, reworked material generated from the manufacturer's own production shall be acceptable as long as the pipe produced meets all the requirements of the Specifications.

- D. Joints for PVC pipe shall conform to ASTM Specification D-3139, latest revision.
- E. Nominal laying length shall be 20 feet. **Minimum length of a cut section of pipe shall be 5 feet.**
- F. Marking on pipe and shall include the following and shall be applied at intervals of not more than 5 feet.
 - 1. Nominal size in inches and OD base (for example, 4 CI).
 - 2. PVC.
 - 3. Dimension ratio (for example, DR 14).
 - 4. AWWA pressure class (for example, PC 305).
 - 5. Test pressure for hydrotested pipe (for example, T330) or if not tested, "NOT HYDROSTATIC PROOF TESTED."
 - 6. AWWA designation number for this standard (ANSI/AWWA C900 or ASTM D-2241).
 - 7. Manufacturer's name or trademark and production run record or lot code.
 - 8. Seal (mark) of the testing agency verifying the suitability of the pipe material for potable-water service.

2.18 DUCTILE IRON PIPE FOR FORCE MAINS

- A. Ductile Iron Pipe shall conform to the requirements of "Ductile-Iron Pipe, Centrifugally Cast" AWWA Standard C151/A21.51, latest revision.
- B. Ductile iron pipe shall be designed in accordance with the requirements of "Thickness Design of Ductile-Iron Pipe", ANSI/AWWA C150/A21.50, latest revision. Minimum pressure class shall be 250 psi.
- C. Joint connections, pipe and fittings (latest revision):
 - 1. Push on and mechanical rubber gasket joints: ANSI/AWWA C111/A21.11.
 - 2. Flanged: ANSI/AWWA C115/A21.15, ANSI B16.1.
 - 3. Grooved and shouldered ANSI/AWWA C606.
- D. Nominal laying length shall be 20 feet. **Minimum length of a cut section of pipe shall be 5 feet.**
- E. Weights and Marking: Weights of pipe and fittings shall conform strictly to the requirements of ANSI Specifications. The weight, class or nominal thickness, and casting period shall be shown on each pipe. The manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "DUCTILE" shall be cast or metal stamped on the pipe, and letters and numerals on pipe sizes 14 in. (356 mm) and larger shall be not less than 1/2 in. (13 mm) in height.

F. Corrosion Control

1. Outside coating shall be an asphaltic coating approximately 1 mil thick. The coating shall be applied to the outside of all pipe.
2. A 40 mil nominal dry film thickness protective lining shall be provided consisting of an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. The lining material shall be Protecto 401 Ceramic Epoxy or approved equal. All cut ends shall be immediately repaired with a field epoxy touch-up kit.
3. Cut sections of pipe shall be immediately repaired with a field kit to restore the ceramic epoxy coating system.
4. Polyethylene wrap in tube or sheet form conforming to the requirements of ANSI/AWWA C105/A21.5, latest revision. The pipe shall be double wrapped.

2.19 VALVES FOR FORCE MAINS

- A. Gate valves up to 12-inch shall be the same as water valves.
- B. Full port (100% area) plug valves shall be AWWA C517, latest revision shall be manufactured by Val-Matic or Dezurik PEC.
- C. Valves shall be installed along the length of the force main, not to exceed 1000' unless a variance is approved by the City for long force mains. All valve boxes shall be marked sewer. An empty valve box shall be installed in the vicinity of the discharge manhole and at fittings that cause a change in direction where the tracer wire can be brought to grade for a point of connection to aid in tracing the force main. A 2-inch SCH-40 PVC pipe shall be installed in the empty valve box. The pipe shall have a pipe marker label affixed and further labeled "No Valve, Tracer Wire Only." All lids shall have the word "SEWER" and a concrete pad with a minimum of 18 inches square or round dimension as appropriate. This shall be for both paved and unpaved applications.

2.20 AIR / VACUUM RELIEF VALVES

- A. Sanitary sewer force mains shall be designed to avoid the need for air or vacuum release lines. If possible, force mains shall be designed without high points and with the top of the force main below the hydraulic grade line at the minimum pumping rate so that relief valves will not be needed.
- B. If high points in the force main can not be eliminated, a stainless steel A.R.I. sewage air release valve or approved equal shall be installed at each significant high point where air could become trapped. The air release valve shall be installed in a manhole structure in accordance with the requirements of Section 3300-Manholes, and provisions shall be required for draining the structure. A high point shall be considered significant if it is 2 feet or more above the minimum hydraulic grade line, or, when pumping is intermittent, above the static head line.

2.21 TRACER WIRE

- A. Tracer wire shall be 12-gauge solid coated copper or 14-gauge coated copper clad steel for underground burial.
- B. Jacket color shall be GREEN, and made of High Density Polyethylene (HDPE) or High Molecular Weight Polyethylene (HMWPE) designed for direct burial.
- C. Connectors shall be used for all splices or repairs. Connectors shall be moisture displacement style as manufactured by 3M DBR, or equal.
- D. A locate or conductivity test shall be performed prior to signing off on the project.

2.22 MARKING TAPE

- A. Non-metallic sanitary sewer marking tape shall be warning tape as manufactured by Rhino Marking and Protection Systems, Harris Industries, Inc., or approved equal.
- B. Tape shall have a minimum thickness of 4 mils and manufactured with heavy metal-free polyethylene tape that is impervious to all known alkalis, acids, chemical reagents, and solvents found in soil. The minimum overall width of the tape shall not be less than 3-inches. Standard rolls shall be 1000' length.
- C. The tape shall be color coded Safety Green and imprinted with the following message: Caution – Buried Sewer Line Below

2.23 SEWER LINE MARKERS

- A. Sewer line markers shall be TriView Marking System by Rhino Marking and Protection Systems, Carsonite International Dual-Sided Utility Marker (CIB-380), or approved equal. All markers shall be installed according to the manufacturer's recommendations. The uppermost portion of the Carsonite marker shall be made of Visibility Enhancer (CVE-360), or approved equal and must be bolted to the utility marker. TriView markers do not require visibility enhancers. The utility marker shall read as follows: "CAUTION, SEWER PIPELINE", "City of Fayetteville", and "Before Digging Call 1-800-482-8998". The label shall also include the official City Logo and be white in color with green and black lettering. The label shall be affixed to two sides of the marker. **An additional white 1" wide reflective tape (3M or equal) shall be placed around the full circumference of the top of the marker.** Concrete shall be placed 6-inches around and 1-foot deep around the base of each marker.

- B. Sewer line pipeline markers shall be installed beside all manholes that are located in easements and backyards. Manholes located in front yards and in streets do not require markers.
- C. Sewer line pipeline markers shall be installed along sewer force mains at valves and at significant fittings that cause a change in direction.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Sanitary Sewer Pipelines: Refer to Section 3100
- B. Sanitary Sewer Service Lines: Refer to Section 3200

END OF SECTION 3000

SECTION 3100

INSTALLATION OF SEWER PIPE, FITTINGS, AND MATERIALS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Installation of sanitary sewer pipelines.
- B. Point repairs on existing sanitary sewer pipelines.

1.02 RELATED WORK

- A. Section 2300 - Excavation, Backfilling, and Compacting.
- B. Section 3000 – Sewer Pipe, Fittings, and Materials.
- C. Section 3200 - Sanitary Sewer Service Lines.
- D. Section 3300 - Manholes.
- E. Section 3600 - Cast-in-place Concrete.
- F. Section 5200 - Inspection and Testing of Sewer Lines, Manholes, and Service Lines.
- G. Section 6000 - Pavement Repair.

1.03 DEFINITIONS

- A. New Sewer Lines – Sewer lines installed in such a manner that there is no sewage flow during construction.
- B. Replacement Sewer Lines – Sewer lines installed in a trench while there is a flow from "live" service connections.
- C. Point Repairs - Replacement of a short section (less than 50 feet in length) in an existing sewer lines.
- D. Force Mains - Sewer pipelines that transport wastewater under pressure from a pump station to a discharge point.

1.04 QUALITY ASSURANCE

- A. Inspect all sewer lines per Section 5200 - Inspection and Testing of Sewer Lines, Manholes, and Service Lines.

1.05 SUBMITTALS

- A. Submit to the Engineer for approval all materials and procedures not described in these specifications.

1.06 REFERENCES

- A. Not Used.

1.07 PROTECTION

- A. In all cases, the Contractor is responsible for protecting public and private property; protecting any person or persons who might be injured as a result of the Contractors' Work.
- B. All utilities shown on the plans may not represent the exact location; however, the Contractor is responsible for verifying these locations and contacting "Arkansas One Call System" before excavating.

PART 2 - PRODUCTS

2.01 BEDDING AND BACKFILL

- A. Refer to Section 2300 - Excavation, Backfilling, and Compacting.

2.02 PIPE, FITTINGS, AND MATERIALS

- A. Refer to Section 3000 – Sewer Pipe, Fittings, and Materials.

2.03 MANHOLES, MANHOLE FRAMES, AND COVERS

- A. Refer to Section 3300 - Manholes.

2.04 CONCRETE

- A. Refer to Section 3600 - Cast-In-Place Concrete.

PART 3 - EXECUTION

3.01 EXCAVATION - GENERAL

- A. Perform excavation and prepare bedding in accordance with Section 2300 - Excavation, Backfilling, and Compacting.
- B. Never lay pipe in a water-filled trench, or when trench conditions or weather are unsuitable for such Work.
- C. Divert surface water and de-water trenches during excavation.
- D. Excavate for bells so that the entire barrel of the pipe will be uniformly supported on the pipe bedding before placing pipe in the trench.

3.02 LAYOUT

- A. The Contractor shall install sewer lines, wyes, and manholes as shown on the Plans.

3.03 SHALLOW BURY

- A. Ductile iron pipe shall be required when the existing grade or the proposed finish grade, whichever is less, provides less than 36 inches of cover. The ductile iron pipe shall extend from manhole to manhole. The ductile iron pipe shall meet the requirements of Section 3000 – Sewer Pipe, Fittings, and Materials, of these Specifications.

3.04 PIERS

- A. Install concrete piers as indicated on the plans per Section 3600 - Cast-In-Place Concrete.

3.05 STEEP GRADES

- A. Whenever the grade of the sewer line exceeds 15 percent, ductile iron pipe shall be required. The ductile iron pipe shall meet the requirements of Section 3000 – Sewer Pipe, Fittings, and Materials, of these Specifications.
- B. Sewers on 15 percent slopes or greater shall be anchored securely with concrete anchors spaced as follows:
 - 1. Not over 36 feet center to center on grades 15 percent and up to 35 percent.
 - 2. Not over 24 feet center to center on grades 35 percent and up to 50 percent.
 - 3. Not over 16 feet center to center on grades 50 percent and over.

- C. Anchor collars should be placed on downstream side of bell. Where no bell is available, a retainer gland shall be installed.

3.06 CONCRETE DAM

- A. Concrete dams shall be constructed at each connection location of new sewer pipe to the existing sewer system. Dams are to be constructed to control the migration of groundwater from the new sewer trench to the exiting sewer system. Dams shall be constructed in the sewer trench, outside the limits of excavation for manholes.
- B. Hand excavate around the sewer pipe into undisturbed earth a minimum of six inches into bottom of the trench and the trench wall perpendicular to the pipe. The hand excavated void around the pipe shall be filled with concrete and a form shall be used to hold the concrete in place. The form may be left in place after backfilling and restoration. The dam shall be a minimum 8-inches thick and extend two (2) feet above the top of the bedding for the pipe.

3.07 PIPE INSTALLATION

- A. Inspect each joint of pipe carefully internally and externally before it is placed in the trench. Plainly mark and separate from the remaining pipe any joint found to be cracked, warped, or otherwise damaged. Remove these damaged joints from the project site as soon as possible.
- B. Cut pipe in a neat and workmanlike manner without damage to pipe or pipe lining when trimming joint length. Cut ends shall be beveled according to the manufacturer's recommendations to prevent damage to the bell gasket. Cut ends for Protecto 401 lined pipe shall be immediately repaired using a field repair kit.
- C. Lay all pipe with the bell upstream.
- D. Use proper equipment for lowering sections of pipe into trenches. Lower pipe carefully into the trench so the spigot and bell will not become contaminated.
- E. Lay each pipe joint to line and grade using laser beam grade light, keeping a minimum of six inches between the pipe and the trench wall.
- F. Keep the pipe joints' interior clean from all dirt and other foreign matter as the Work progresses. Maintain the pipe's interior cleanliness until accepted or put in service.
- G. Close the open ends of the pipeline temporarily with an appropriate manufactured watertight plug at the end of each day's Work or when discontinuing pipe installation for an appreciable period.

H. COLD WEATHER INSTALLATION

1. The City reserves the right to order pipe installation discontinued whenever, in its opinion, there is danger of the quality of work being impaired because of cold weather. The Contractor shall be responsible for heating the pipe and jointing material so as to prevent freezing of joints. Do not lay any pipe on frozen ground. No flexible or semi-rigid pipe shall be laid when the air temperature is less than 32° F unless proper precautions per the manufacturer's recommendations are taken by the Contractor and the method is approved by the Engineer and City.
2. When pipes with rubber gaskets or resilient-type joints are to be laid in cold weather, sufficiently warm the gasket or joint material so as to facilitate making a proper joint.

I. TRACER WIRE

1. Tracer wire shall be installed on all buried sewer pipelines. This includes gravity sewer mains, sewer force mains, and gravity sewer laterals.
2. Tracer wire shall be installed 6-inches above the top of the pipe.
3. Tracer wire shall be CAD welded to the cast iron manhole frame.

J. MARKING TAPE

1. Marking tape shall be installed on all buried sewer pipelines. This includes gravity sewer mains, sewer force mains, and gravity sewer laterals.

3.08 PIPE TO PIPE CONNECTIONS

- A. Make all pipe joints in strict accordance with the manufacturer's recommendation and as stated below for the particular type of connection. Make all joints watertight in accordance with the latest ASTM Standards.
- B. Slip-type or Push-on Joints Connection Procedure
1. Clean the bell and spigot end of the pipes prior to jointing thoroughly with a brush. Exercise particular care to clean the gasket seat.
 2. Apply pipe lubricant and attach gasket in strict accordance with the specific joint manufacturer's recommendations. Clean and insert the rubber gasket in the gasket seat within the bell. Insert the spigot end of the upstream pipe in the bell of the downstream pipe. Push the upstream joint until it is in firm contact with the shoulder of the bell.

C. Mechanical Joints Connection Procedure

1. Clean thoroughly the spigot end of the pipe, the bell of the connecting pipe, and the rubber gasket as specified for slip-type or push-on joints. Clean the gland in a similar manner.
2. After the gland and gasket are placed on the spigot end of the pipe, a sufficient distance from the end to avoid fouling the bell, insert the spigot end in the fitting bell to the point of firm contact with the bell shoulder. Then advance the rubber gasket into the bell and seat in the gasket seat. Exercise care to center the spigot end within the bell. Bring the gland into contact with the gasket, enter all bolts, and make all nuts hand tight. Exercise continued care to keep the spigot centered in the bell.
3. Make the joints tight by turning the nuts with a torque wrench: First partially tightening a nut, then partially tightening the nut 180 degrees away from it. Work around the pipe with uniformly applied tension until the required torque is applied to all nuts. Required torque ranges and indicated wrench lengths for bolts are as follows:

Diameter <u>Inches</u>	Range of Torque		Length of Wrench <u>Inches</u>
	<u>Foot</u>	<u>Pounds</u>	
5/8	40 – 60		8
3/4	60 – 90		10
1	70 – 100		12
1-1/4	90 – 120		14

D. Reinforced Flexible Rubber Couplings

1. Install reinforced flexible rubber coupling only where dissimilar pipe materials are connected.
2. Take care that proper alignment is maintained and a maximum spacing between pipes does not exceed one-half inch.
3. Encase reinforced flexible rubber coupling in Class A concrete as shown on the Standard Details.

3.09 WYE FITTINGS FOR SERVICE CONNECTIONS

- A. Use in-line wye fittings for all service connections except on ductile iron pipe and polyethylene pipe.
- B. The wye material and joint type must match that of the mainline pipe.

- C. Use taps instead of wyes only on ductile iron pipe and polyethylene pipe.
- D. Install wye branches at the location of live services or as indicated on the construction plans. Install wye connections for services in accordance with the manufacturer's recommendations.
- E. Place Class "A" concrete under each wye branch to prevent cracking or twisting under earth loads.
- F. Mark wyes for future connections using marking tape, tracer wire, yellow nylon rope, and 1/2" x 4' rebar or fence tee-post.
- G. Terminate wyes for future connections in a bell suitable for connection of a four-inch SCH-40 PVC service line. Securely plug all wyes and service stubs for future connections.
- H. For Service Wye Details, see the Standard Detail Drawings.

3.10 CLEANOUTS FOR SERVICE CONNECTIONS

- A. Install cleanouts on service lines at the property line where the main line is in the paved right-of-way, as required by plumbing code, or as indicated on the construction plans.
- B. For Cleanout Details, see the Standard Detail Drawings.

3.11 BACKFILLING AND INSPECTION

- A. Before backfilling, place concrete encasement at transitions between different types of pipe and around all flexible rubber couplings as shown on the Drawings. Use Class A concrete per Section 3600-Cast-In-Place Concrete.
- B. Before backfilling, install concrete anchor collars in accordance with the details at the location and interval and shown on the Drawings. Use Class B concrete and reinforce with steel bars per Section 3600-Cast-In-Place Concrete.
- C. After the pipeline is installed and visually inspected by the Engineer, backfill the trench per Section 2300-Excavation, Backfilling, and Compacting.
- D. Test the pipeline per Section 5200-Inspection and Testing of Sewer Lines, Manholes, and Service Lines.
- E. Repair all pavements per Section 6000-Pavement Repair.
- F. Repair all incidental damage to buildings, structures, utilities, pavements, landscaping, etc.

- G. Repair sodded and grass areas to original condition.

3.12 CONNECTION OF NEW SEWER LINES TO EXISTING SEWER LINES

- A. Construct, clean, test, and obtain Engineer's approval for sewer lines and manholes before connecting new sewer lines to the existing sewer.
- B. If, in the opinion of the Engineer, conditions exist which require connection prior to final line acceptance, plug all lines entering the manhole connecting to the existing system until the new system is accepted. In addition, plug the line leaving the first manhole upstream. Never allow water being used to flush the new lines to enter the existing system.
- C. All new sewer lines must connect to the existing system at a new or existing manhole. If a new manhole is built over an existing sewer line, do not break out the top of the existing pipe until the new line is accepted.
- D. If a new sewer line is to discharge into an existing manhole, divert the sewage flow around the existing manhole while the tie-in is under construction. Intercept the sewage flow at the existing manhole first upstream from the tie-in construction. Provide suitable pumping equipment and re-routing conduit to pump the sewage around the tie-in construction. Discharge into an appropriate manhole downstream from the construction.
- E. Connection to an existing manhole shall be made by core drilling. A concrete manhole adapter shall be installed on the sewer pipe, and the annular space grouted in accordance to Section 3300 – Manholes.
- F. Connect new sewer lines to existing manholes in a neat, workmanlike manner, to ensure a watertight connection.

3.13 GRAVITY SEWER LINE INSTALLATION – LIVE SEWER LINES AND POINT REPAIRS

- A. Install sewer lines and point repairs as detailed above for new sewer lines with the following exceptions:
 - 1. Divert all upstream flow around the section to be replaced with plugs or pumps. The bedding must be kept dry during installation. If trench bottom is too wet, excavate wet portion and replace with bedding material.
 - 2. Make transitions to original pipe using materials and procedures specified. Take care that replacement pipe is aligned properly with no offsets. Install concrete encasement around transitions. Take care that no concrete from the encasement enters the existing pipeline. If this occurs, remove the concrete.

3. At the end of each day's work, and when for any reason the laying of pipe will be discontinued for an appreciable period, place a temporary section of pipe in the live line.
4. Pressure testing is not required. Visual and television testing are required.
5. Mandrel testing is required.
6. Service line pressure testing is not required.
7. A temporary debris catcher, as shown in the Standard Detail Drawings, shall be used in the downstream manhole.

3.14 GRAVITY SEWER LINE INSTALLATION - AERIAL CROSSINGS

- A. Construct piers as shown on Drawings.
- B. Install encasement pipe on piers to grade.

3.15 FORCE MAIN PIPE INSTALLATION

- A. Install all pipe and fittings to the line and grade as detailed on the Drawings. All bolted valves, fittings, etc. shall be installed the same as water lines. Refer to Section 4100.
- B. **The force main shall have tape marked sewer wrapped around the pipe with complete revolutions not to exceed 6'. Tape marked sewer shall also be installed in the trench 18" above the top of the sewer force main.**
- C. Remove all dirt and other foreign matter from the inside of pipe and fittings before they are lowered into the trench. Keep pipe and fittings clean during and after laying. Take care to keep dirt out of the bells. Plug all pipe openings at the end of each days work or when pipe laying is discontinued.
- D. Use proper equipment for lowering sections of pipe into trenches. Lower pipe carefully into the trench so the spigot and bell will not become contaminated.
- E. Cut pipe in a neat and workmanlike manner without damage to pipe or pipe lining when trimming joint length.
- F. Install pipe with bell ends facing in the direction of laying. Face bells upgrade on lines on an appreciable slope.

- G. When necessary to deflect pipe from a straight line in either the horizontal or vertical plan to avoid obstructions, do not deflect the pipe beyond the point recommended by the pipe manufacturer.
- H. Before backfilling, install concrete thrust blocking in accordance with Standard Details on Plans. Thrust blocking shall be designed based on pressures of at least 25 percent greater than the maximum pump design shutoff head plus a water hammer allowance with an appropriate factor of safety.
- I. All force mains shall be equipped with a Pig Launch & Retrieval System. Refer to Standard Details.
- J. Sewer line pipeline markers shall be installed beside all manholes and valve boxes that are located in easements and backyards. Manholes and valve boxes located in front yards and in streets do not require markers.
- K. Test the pipeline per Section 5200-Inspection and Testing of Sewer Lines, Manholes, and Service Lines.
- L. After the pipeline is installed and visually inspected by the Engineer, backfill the trench per Section 2300-Excavation, Backfilling, and Compacting. Repair all pavements per Section 6000-Pavement Repair. Repair all incidental damage to buildings, structures, utilities, pavements, landscaping, etc.
- M. Repair sodded and grass areas to original condition.

3.16 INSTALLATION OF POLYETHYLENE PROTECTION MATERIAL

- A. Polyethylene material, either in tubing form or in the form of flat sheet or rolls, as specified herein, shall be placed around all buried mechanical joints of pipe and fittings, valves, sleeves, couplings, and any other appurtenance with exposed bolts. Any and all iron or steel components installed below ground shall be double wrapped with the polyethylene material.
- B. Ductile iron and steel pipe and appurtenances shall be completely encased in polyethylene tubing material. It is not the intent that the material form an enclosure that is absolutely air or water tight, but to prevent pipe to soil contact.
- C. Polyethylene tubing shall be applied to pipe in double layers by one of the following methods:
 - 1. Method "A": Cut polyethylene tubes to a length approximately two feet (2') longer than the length of the pipe section. Slip the tubes around the pipe, centering it to provide a one foot (1') overlap on each adjacent pipe section, and bunching it accordion fashion lengthwise until it clears the pipe ends. Lower the pipe into the trench and make up the pipe joint with the preceding

section of pipe. A shallow bell hole must be made at joints to facilitate installation of the polyethylene tube. After assembling the pipe joint, take bunched polyethylene from the preceding length of pipe, slip it over the end of the new length of pipe, and secure in place. Then slip the end of the polyethylene from the new pipe section of the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Secure the overlap in place. Take up the slack width to make snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points with tape.

2. Method "B": Cut polyethylene tubes to a length approximately one foot (1') shorter than the length of the pipe section. Slip the tubes around the pipe, centering it to provide six inches (6") of bare pipe at each end. Make polyethylene snug, but not tight; secure ends. Before making up a joint, slip two sections of three foot (3') length of polyethylene tube over the end of the preceding pipe section, bunching it accordion fashion lengthwise. After completing the joint, pull the two sections of three foot (3') length of polyethylene over the joint, overlapping the polyethylene previously installed on each adjacent section of pipe by at least one foot (1'); make snug and secure each end.

- D. Pipe-Shaped Appurtenances. Bends, reducers, offsets, and other pipe-shaped appurtenances shall be covered with double layers of polyethylene in the same manner as the pipe.
- E. Odd-Shaped Appurtenances. Valves, tees, crosses and other odd-shaped pieces which cannot practically be wrapped in a tube, shall be wrapped with two layers of flat sheets or split length of polyethylene tubes. The sheets shall be passed under the appurtenance and brought up around the body. Seams shall be made by bringing the edges together, folding over twice, and taping down. Slack width and overlaps at joints shall be handled as described in Paragraph 3.13.C.1 above. Tape polyethylene securely in place at valve stem and other penetrations.
- F. Openings in Tubing Material. Openings for branches, service taps, blow-offs, air valves, and similar appurtenances shall be made by making an "X" shaped cut in the polyethylene and temporarily folding the film back. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut, as well as any other damaged areas in the polyethylene with tape.
- G. Junctions Between Wrapped and Unwrapped Pipe. Where polyethylene wrapped pipe joins a pipe that is not wrapped, extend the polyethylene tube to cover the unwrapped pipe a distance of at least two feet (2') and secure the end.
- H. The polyethylene material shall be secured around the pipe and appurtenances by at least three (3) circumferential wraps of tape (see Section 3000 for materials).

- I. All tongs, cables, or chains that are used for lifting pipe and appurtenances that have been encased in polyethylene material shall be adequately padded to prevent damage to the material.
- J. Repair any rips, punctures, or other damage to the polyethylene with tape or with a short length of polyethylene tube cut open, wrapped around the pipe and secured in place.
- K. Polyethylene material shall be stored on the job site in such a manner that it is not exposed to direct sunlight. Exposure during installation shall not exceed forty-eight (48) hours.
- L. Backfill material shall be the same as specified for pipe without polyethylene wrapping. Special care shall be taken to prevent damage to the polyethylene wrapping when placing backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, and/or other material that could damage polyethylene.

3.17 WATER LINE CROSSINGS

- A. Sewer lines installed under a water line must have a clear distance between pipes of at least eighteen (18) inches.
- B. The sewer line shall be installed such that a joint of pipe is centered along the water line and the joints are as far as possible from the water line.
- C. If 18-inches of clearance cannot be provided or when the water main must pass under the sewer main, either the sanitary sewer main or the water main shall be encased in twenty (20) feet of watertight encasement pipe, centered over the point of crossing. Crossings that are not perpendicular will require more than twenty (20) feet of encasement. The encasement shall extend a minimum of ten (10) feet perpendicular from the outside edges of the line that is not being encased. The ends of the encasement pipe shall be sealed watertight. Refer to Section 3400 – Steel Encasement Pipe.

3.18 STORM SEWER CROSSINGS

- A. All sewer lines crossing under all concrete storm drains, or any storm drain 30-inch diameter and larger, or all storm drains with multiple pipe runs, shall be installed in steel encasement a minimum of 5 feet either side of the storm drain.

END OF SECTION 3100

SECTION 3200

INSTALLATION OF SEWER SERVICE LINES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers:
 - 1. Installation of sanitary sewer service lines.
 - 2. Point repairs on existing sanitary sewer service lines.
- B. Sewer lines 6 inches in diameter and larger are constructed under the requirements of Section 3100 - Sanitary Sewer Pipelines.

1.02 RELATED WORK

- A. Standard Detail Drawings
- B. Section 1000 – General Requirements and Procedures
- C. Section 2300 – Excavation, Backfilling, and Compacting
- D. Section 3000 – Sewer Pipe, Fittings, and Materials
- E. Section 3100 – Installation of Sewer Pipe, Fittings, and Materials
- F. Section 3300 – Manholes
- G. Section 3600 – Cast-In-Place Concrete
- H. Section 5200 – Inspection and Testing of Sanitary Sewer Lines, Manholes, and Service Lines
- I. Section 6000 – Pavement Repair
- J. Section 6100 – Lawn and Grass Restoration

1.03 DEFINITIONS

- A. City Sewer Main - A public sanitary sewer in which all owners of abutting properties have equal rights and is maintained and controlled by the City of Fayetteville. No sewer line smaller than six (6) inches in diameter is a city sewer.

- B. Service Line - The sewer which conveys the discharge from a building's plumbing system or other approved waste system to the city sanitary sewer system. The service line begins at the connection to the city sanitary sewer and ends at the building foundation.
- C. Permit - Written authorization issued to a plumber or contractor upon request allowing installation of a service line to connect to the City of Fayetteville collection system.
- D. Plumbing Permit - Written authorization issued to a plumber or contractor upon request allowing work on existing plumbing in an existing structure or to install plumbing in a new or existing structure.

1.04 QUALITY ASSURANCE

- A. Inspect all service lines per Section 5200 - Inspection and Testing of Sanitary Sewer Pipelines, Manholes, and Service Lines.

1.05 SUBMITTALS

- A. Submit to the Engineer for approval all materials and procedures not described in these specifications.

1.06 REFERENCES

- A. Arkansas State Plumbing Code
- B. City of Fayetteville Plumbing Code

1.07 SPECIAL REQUIREMENTS CONCERNING FIELD LOCATION OF PIPE, BENDS, CLEANOUTS, AND MANHOLES ON SERVICE LINES

- A. Bends
 - 1. Avoid using short radius ninety degree bends on 4" service lines.
 - 2. Use only long sweep bends where bends are absolutely necessary.
- B. Cleanouts
 - 1. Cleanouts are required at the building foundation per the City of Fayetteville Plumbing Code.
 - 2. On lines longer than one hundred (100) feet, cleanouts are required at one hundred (100) foot spacing.
 - 3. Install cleanouts adjacent to any ninety degree bend.

4. Install pipe on cleanout riser up to finish grade.
5. The cleanout shall be the same diameter as the pipe on which it is installed.

C. Backwater Traps (Sewage check valve)

1. Provide backwater traps as required by Section 715 – Backwater Valves of the Arkansas Plumbing Code or as shown on the Drawings.
2. Place backwater traps in a meter box to allow periodic servicing.

1.08 PROTECTION

- A. In all cases the Contractor is responsible for protecting public and private property; and, protecting any person or persons who might be injured as a result of the Contractor's work.
- B. All utilities shown on the plans may not represent the exact location; however, the contractor is responsible for verifying these locations and contacting "Arkansas One Call System" before excavating.

PART 2 - PRODUCTS

2.01 BEDDING AND BACKFILL

- A. Refer to Section 2300 – Excavation, Backfilling, and Compacting.

2.02 PIPE AND FITTINGS

- A. Refer to Section 3000 – Sewer Pipe, Fittings, and Materials for allowable materials.

2.03 BACKFILL AND ASPHALT FOR PAVEMENT REPAIRS

- A Refer to Section 6000 – Pavement Repair

2.04 MANHOLES, MANHOLE FRAMES, AND COVERS

- A. Refer to Section 3300 – Manholes

2.05 CONCRETE

- A. Refer to Section 3600 – Cast-In-Place Concrete

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Perform excavation and prepare bedding in accordance with Section 2300 - Excavation, Backfilling, and Compacting.
- B. Never lay pipe in a water filled trench.
- C. Excavate for bells so that the entire barrel of the pipe will be uniformly supported before placing pipe in the trench.

3.02 PIERS

- A. Install concrete piers as indicated on the plans in accordance with Section 3600 - Cast-In-Place Concrete.
- B. Use steel encasement pipe on piers.

3.03 PIPE INSTALLATION

- A. Inspect each joint of pipe carefully before it is placed in the trench. Discard damaged joints.
- B. If trimming joint length is required, cut pipe in a neat and workmanlike manner without damage to pipe or pipe lining.
- C. Lay all pipe with the bell upstream.
- D. Lower pipe carefully into the trench so the spigot and bell will not become contaminated.
- E. Lay the service line on a straight alignment and at a constant slope. Install pipe a minimum slope of one percent (1.00%); this equals one-eighth inch fall per lineal foot (1/8" / LF). The maximum allowable deflection in a horizontal plane is one inch per lineal foot (1.00"/LF).
- F. Install bends on 4" service lines at all changes in alignment and slope. Cleanouts are required at 90 degree bends and every 100 feet on lines longer than 100 feet. Bends on 6" and larger service lines are only permitted within 5 feet of the building foundation and 2 feet of the manhole being connected to; if longer than 150 feet, bends are not allowed and manholes must be built.
- G. Keep the pipe joints' interior clean from all dirt and other foreign matter as the work progresses. Maintain the pipe's interior cleanliness until accepted or put in service.

- H. At the end of each day's work, and when for any reason the laying of pipe will be discontinued for an appreciable period, close the open ends of the pipeline temporarily with an appropriate manufactured plug.

3.04 PIPE TO PIPE CONNECTIONS

- A. Make all pipe joints in strict accordance with the manufacturer's recommendation and these specifications as stated below for the particular type of connection. Make all joints watertight in accordance with the latest ASTM Standards.
- B. "No-Hub" type pipe connections are not permitted.
- C. Slip-Type Or Push-On Joints Connection Procedure
 - 1. Clean the bell and spigot end of the pipes prior to jointing thoroughly by whatever means necessary to remove all foreign matter and attain the required cleanliness. Use a brush as necessary. Exercise particular care to clean the gasket seat.
 - 2. Apply lubricant and attach gasket in strict accordance with the specific joint manufacturer's recommendations. Clean and insert the rubber gasket in the gasket seat within the bell. Insert the spigot end of the pipe in the bell of the pipe to which connection is being made, and force a firm contact with the shoulder of the bell.
- D. Mechanical Joints Connection Procedure
 - 1. Clean thoroughly the spigot end of pipe, the bell of fitting, and the rubber gasket as specified for slip-type or push-on joints. Clean the gland in a similar manner.
 - 2. After the gland and gasket are placed on the spigot end of the pipe a sufficient distance from the end to avoid fouling the bell, insert the spigot end in the fitting bell to the point of firm contact with the bell shoulder. Then advance the rubber gasket into the bell and seat in the gasket seat. Exercise care to center the spigot end within the bell.
 - 3. Bring the gland into contact with the gasket, enter all bolts, and make all nuts hand tight. Exercise continued care to keep the spigot centered in the bell.
 - 4. Make the joints tight by turning the nuts with a wrench - first partially tightening a nut, then partially tightening the nut 180 degrees therefrom and working thus around the pipe with uniformly applied tension until the required torque is applied to all nuts. Required torque ranges and indicated wrench lengths for stainless steel bolts are shown in Section 3100 - Sanitary Sewer Pipelines.

E. Reinforced Flexible Rubber Couplings

1. Install a reinforced flexible rubber coupling only where dissimilar pipe materials are mated.
2. Take care that proper alignment is maintained.
3. Encase reinforced flexible rubber coupling in Class A concrete as shown on the Standard Details.

3.05 SERVICE LINE CONNECTIONS TO CITY SEWER PIPELINES

A. Wye connection - Use existing wye or other prefabricated outlet if one has been left in the city sewer for sewer service to a lot unless it can be shown that the dwelling unit or building cannot drain by gravity to the wye.

B. Taps

1. Where a wye or other prefabricated outlet in the city sewer is not available to serve a lot, a tap connection shall be installed at a location approved by the City to connect the building sewer to the city sewer.
2. The City shall install all taps using approved materials and equipment after the tap fee has been paid.

C. Manhole Taps

1. Manhole taps are only permitted on end-of-line manholes. Make manhole tap connections into existing manholes as indicated on the Drawings.
2. Install manhole taps no more than twenty-four (24) inches above the manhole invert.
3. Make manhole tap watertight and flush with inside surface of manhole.
4. Manhole taps are considered as part of the service line and are subject to inspection.

3.06 BACKFILLING AND INSPECTION

A. Before backfilling, place concrete encasement at transitions between different types of pipe and around all flexible rubber couplings as shown on the Standard Details.

B. Install backwater traps (Sewage check valve) if required.

C. Before backfilling, install concrete anchor collars in accordance with the details at the location and interval and shown on the drawings. Use Class "B" concrete and reinforce with steel bars per Section 3600 - Cast-In-Place Concrete.

- D. After the pipeline is installed and visually inspected by the Engineer, backfill the trench and clean up the site per Section 2300 - Excavation, Backfilling, and Compacting.
- E. Test the service line per Section 5200 - Inspection and Testing of Sewer Lines, Manholes, and Service Lines.
- F. Repair all pavements per Section 6000 - Pavement Repair.
- G. Repair all incidental damage to buildings, structures, utilities, pavements, landscaping, etc.

3.07 SERVICE LINE REPLACEMENT/REPAIRS

- A. Obtain permit per City of Fayetteville requirements.
- B. When possible, the existing tap or wye should be used to connect a repaired or replaced service line.
- C. When the existing wye or tap cannot be used, then the Contractor shall seal original wye or tap (to prevent entrance or rainwater or debris into the city sewer) and contact the City of Fayetteville to arrange for inspection of seal.
- D. Repair damaged portion in accordance with these specifications.
- E. If reinforced flexible rubber couplings are required, be sure to encase them in Class A Concrete as shown in the Standard Details.
- F. Contact the City of Fayetteville to arrange for inspection of service line repair.

3.08 RELOCATE SERVICE EXIT

- A. Obtain Plumbing Permit from the City of Fayetteville.
- B. Relocate where the sanitary sewer line exits the structure and plug the old sewer line where it was cut to be rerouted.
- C. Have the work inspected by the City Plumbing Inspector.

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END OF SECTION 3200

SECTION 3300

MANHOLES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the materials and procedures used in the construction and repair of sanitary sewer manholes.

1.02 RELATED WORK

- A. Section 2300 – Excavation, Backfilling, and Compacting.
- B. Section 3100 – Installation of Sewer Pipe, Fittings, and Materials.
- C. Section 3200 – Installation of Sewer Service Lines.
- D. Section 3600 – Cast-in-Place Concrete.

1.03 SUBMITTALS

- A. Furnish Shop Drawings and Submittal Data for approval prior to the delivery of any pre-cast manhole sections.
- B. Submit for approval any materials not listed specifically below.

1.05 REFERENCES

- A. Not Used.

1.06 MANHOLE DIMENSIONS AND LAYOUT

- A. Construct all manholes in accordance with the Standard Manhole Details in Standard Detail Drawings.
- B. The required dimensions on manholes are:
 - 1. Cone section height: 24 inches, minimum; 36 inches, maximum.
 - 2. Throat section height: 18 inches, maximum.

- C. Locate the manhole so the centerlines of all pipelines entering and leaving pass through the center of the manhole.
- D. The following are minimum manhole diameters for sanitary sewers entering/exiting a manhole at the following range of angles:

MANHOLE DIAMETERS

Pipe Size	Pipes Entering/Leaving at 0° - 45° Bend	Pipes Entering/Leaving at 45° - 90° Bend
8" - 15"	48"	48"
16" - 30"	60"	60"
33" - 42"	72"	72"

1.07 PROTECTION

- A. In all cases, the Contractor is responsible for protecting public and private property; and, protecting any person or persons who might be injured as a result of the Contractor's work.
- B. All utilities shown on the plans may not represent the exact location; however, the Contractor is responsible for verifying these locations and contacting "Arkansas One Call System" before excavating.

PART 2 - PRODUCTS

2.01 WATER FOR MORTAR AND GROUT

- A. Water: Potable water free from injurious amounts of acids, alkalis, oils, sewage, vegetable matter, and dirt.

2.02 CEMENT

- A. Portland Cement, conforming to AASHTO M 85, Type I.

2.03 MANHOLE GROUT

- A. Cementitious non-shrink grout for use in manholes shall be one specially formulated for stopping active infiltration and filling voids in manholes and similar locations. Grout mix shall provide a quick-setting, volume-stable, cementitious product suitable for patching the interior of manholes when mixed and applied according to the manufacturer's recommendations. Grout mix shall be Strong Seal QSR, or equal.

2.04 CAST-IN-PLACE MANHOLES

- A. Construct with Class B concrete only as outlined in Section 3600 - Cast-In-Place Concrete.
- B. Reinforcement shall be as outlined in Section 3600 - Cast-In-Place Concrete.
- C. The frame for the cover shall be installed when the manhole is constructed.

2.05 PRECAST CONCRETE MANHOLES

- A. Conform to the latest requirements of ASTM C478.
- B. Never transport sections to the site until they have achieved a minimum strength of 3,200 psi (80% of 4,000 psi design) as determined by a concrete cylinder test for the concrete batch.
- C. Mark each piece plainly with manhole numbers and date of manufacture so it can be installed in the proper location, as shown on the plans.
- D. Make sure factory-installed cutouts in the bottom section are appropriate for the pipe being laid.
- E. Pipe connections at manhole - Cutouts should be equipped with rubber boots to ensure a watertight connection. Material shall be equal to A-Lok compression connector or A-Lok G3 Boot System, as manufactured by A-Lok Products, Inc.
- F. Joint Sealant - Flexible rubber sealant for joints in pre-cast manhole sections shall provide permanently flexible watertight joints, shall remain workable over a wide temperature range and shall not shrink, harden or oxidize upon aging. Material shall be equal to RFS Prelubricated Gaskets by Press-Seal Gasket Corporation and shall meet ASTM C 443 and ASTM C 1619 (Classes C and E) requirements.
- G. **No supplemental joint sealant material is permitted.**
- H. All manhole joints shall be sealed with a 6-inch wide butyl external joint wrap material. Material shall be equal to Bidco Butyl Wrap as manufactured by NPC or Infi-Shield® Gator Wrap by Sealing Systems, Inc. The external joint wrap material must be approved by the City of Fayetteville.
- I. The frame for the cover shall be installed after the cone section is installed in the field.
 - 1. Joint surfaces between the frame, adjustments, and cone section shall be free of dirt, stones, debris, and voids to ensure a watertight seal. Place a flexible butyl gasket joint material, E-Z STIK as manufactured by Press-

Seal Gasket Corporation, or equal to ASTM C 990, Section 6.2 Butyl Rubber Sealants, minimum 1/2 inch thick, in two concentric rings along the inside and outside edge of each joint. Position the butt joint for each length of joint material on opposite sides of the manhole. No steel shims, wood, stones, or any material not specifically accepted by the Engineer may be used to obtain final surface elevation of the manhole frame.

2. All grade adjustments, the exterior surfaces of the frame base, and four inches below the top of the manhole cone shall be cleaned with a wire brush and then waterproofed with trowelable bitumastic gasket material, Trowelable EZ-STIK #3 as manufactured by Press-Seal Gasket Corporation, or equal, in accordance with the manufacturer's specifications. A protective polyethylene cover shall be placed over the waterproofing material when backfilling, following sealing of the frame to the manhole. Trowelable bitumastic gasket material is not required if no grade adjustment rings are used.
3. When grade adjustment rings are placed on the manhole structure to obtain proper grade, no more than 18 vertical inches from the top of the frame to the top of the manhole cone may be used.

K. REJECTION OF PRECAST MANHOLE SECTIONS

Precast reinforced concrete manholes, risers and tops shall be subject to rejection for failure to conform to any of the following specification requirements:

1. Fractures or cracks passing through the shell, except for a single end crack that does not exceed the depth of the joint;
2. Defects that indicate imperfect proportioning, mixing and molding;
3. Surface defects indicating honeycombed or open texture;
4. Damaged ends, where such damage would prevent making a satisfactory joint;
5. Infiltration into manhole exceeding allowed limits;
6. The internal diameter of the manhole section shall not vary more than one (1) percent from the nominal diameter;
7. Not clearly marked date of manufacturer, trade name, size designation part number, and ASTM number;
8. Having a deviation more than 1/4" from the straight edge at any point across the top of manhole cone section or riser ring; and/or
9. Having any visible steel bars along inside or outside surface of the manhole except for reinforcement stirrups or spacers used to position the cage during manufacture.

2.06 CORROSION PROTECTION

- A. Manholes located on 15-inch and larger sewer lines shall be epoxy coated on the interior.
- B. Manholes on sewer lines within 100 feet of a 15-inch and larger sewer line shall be epoxy coated on the interior.
- C. The products shall only be applied by personnel thoroughly familiar with handling of the coating material, and in accordance with the manufacturer's specifications, recommendations and requirements.
 - 1. Raven Ultra High-Build Epoxy Coating, designated as Raven 405, with an average thickness of 100 mils and a minimum thickness of 80 mils.
 - 2. Warren Environmental Systems, designated as S-301, with an average thickness of 100 mils and a minimum thickness of 80 mils.
 - 3. All epoxies shall meet the following minimum requirements:

Flexural Strength	ASTM D790	6,000 psi
Compressive Strength	ASTM D695	8,000 psi
Tensile Strength	ASTM D638	4,000 psi
Tensile Elongation	ASTM D638	4%
Adhesion	ASTM D4541	Concrete Substrate Failure
- D. **Any damage to an epoxy system on existing manholes shall be repaired by the City at the expense of the contractor.**

2.07 MANHOLE DROP

- A. Drop on the outside of the manhole: Concrete encased PVC pipe and fittings as specified in Section 3000 – Sewer Pipe, Fittings, and Materials.

2.08 STANDARD MANHOLE FRAME AND COVER

- A. Covers located on manholes owned by the City of Fayetteville, generally within the Fayetteville City Limits, shall have the words FAYETTEVILLE ARKANSAS SANITARY SEWER and PERMIT REQUIRED CONFINED SPACE cast in the top. Also, include two closed pick holes in top side of cover.
- B. Covers located on manholes operated and maintained by the City of Fayetteville, generally outside the Fayetteville City Limits, shall have the words SANITARY SEWER and PERMIT REQUIRED CONFINED SPACE cast in the top. Also, include two closed pick holes in top side of cover.
- C. Minimum combined weights of the manhole frame and cover is 210 pounds. Minimum cover weight is 110 pounds. Minimum frame weight is 100 pounds.

- D. All casting shall be AASHTO H-20 rated.
- E. All castings shall be cast with the approved foundry's name, manufacturing foundry mark, part number, and production date in mm/dd/yy format. All castings shall be manufactured in the USA and shall be clearly marked "Made in USA."
- F. All castings: Free from porosity, blowholes, hard spots, shrinkage, distortion and other defects; smooth and well cleaned by sandblasting; manufactured true to pattern.
- G. Frame and cover dimensions: Refer to Standard Detail Drawings. Final casting dimensions may vary one-half the maximum shrinkage possessed by the metal or no more than +/- 1/16 inch per foot.
- H. Cover and frame bearing surface: smooth finish, non-rocking design or machined bearing surfaces to prevent rocking and rattling under traffic.
- I. Cast Iron: ASTM A 48, Class 35B.
- J. Ductile Iron: ASTM A 536, Grade 80-55-06.

2.09 HINGED AND GASKETED MANHOLE FRAME AND COVER

- A. Manhole frame shall be cast or ductile iron. Manhole cover shall be ductile iron. Seal shall be by replaceable t-gasket.
- B. Covers located on manholes owned by the City of Fayetteville, generally within the Fayetteville City Limits, shall have the words FAYETTEVILLE ARKANSAS SANITARY SEWER and PERMIT REQUIRED CONFINED SPACE cast in the top. Also, include two closed pick holes in top side of cover.
- C. Covers located on manholes operated and maintained by the City of Fayetteville, generally outside the Fayetteville City Limits, shall have the words SANITARY SEWER and PERMIT REQUIRED CONFINED SPACE cast in the top. Also, include two closed pick holes in top side of cover.
- D. Hinged and gasketed manhole frame and cover shall open to 120°, remove at 120°, and have a safety stop at 90°.
- E. All casting shall be AASHTO H-20 rated.
- F. All castings shall be cast with the approved foundry's name, manufacturing foundry mark, part number, and production date in mm/dd/yy format. All castings shall be manufactured in the USA and shall be clearly marked "Made in USA."
- G. All castings: Free from porosity, blowholes, hard spots, shrinkage, distortion and other defects; smooth and well cleaned by sandblasting; manufactured true to pattern.

- H. Frame and cover dimensions: Refer to Standard Detail Drawings. Final casting dimensions may vary one-half the maximum shrinkage possessed by the metal or no more than +/- 1/16 inch per foot.
- I. Cover and frame bearing surface: smooth finish, non-rocking design or machined bearing surfaces to prevent rocking and rattling under traffic.
- J. Cast Iron: ASTM A 48, Class 35B.
- K. Ductile Iron: ASTM A 536, Grade 80-55-06.
- L. Frame shall be anchored to the manhole cone per standard detail.

2.10 MANHOLE STEPS

- A. Manhole steps shall **NOT** be installed in any manholes.

2.11 RUBBER WATERSTOP GASKETS

- A. Waterstop gaskets shall be required at **ALL** manhole connections. Manhole seals shall be concrete manhole adapter by Fernco, A-Lok, or approved equal.

2.12 MANHOLE RISER RING

- A. Manhole riser rings shall be compatible with the size and type of manhole cover with which it will be used.
- B. A maximum of 6 inches of riser rings shall be permitted. Adjustments greater than 6 inches will require grade adjustment rings.

2.13 MANHOLE GRADE ADJUSTMENT RINGS

- A. Grade adjustment rings shall be required to adjust the frame and cover to grade as required.
- B. Sloped grade adjustment rings may be required to match the slope of paved areas.
- C. Grade adjustment rings shall be injection molded, recycled HDPE as manufactured by Ladtech, Inc.

2.14 RAIN STOPPERS (MANHOLE INSERT)

Rain stoppers shall be installed in ALL manholes that are not hinged with gaskets.

A. Polyethylene Insert

1. The manhole insert shall be of corrosion-proof high density polyethylene that meets or exceeds the requirements of ASTM D1248, Category 5, Type III with a minimum impact brittleness temperature of -180°F.
2. The minimum thickness of the manhole insert shall be 3/16".
3. The manhole insert shall have a strap for removing the insert. The strap shall be made of minimum 1" wide woven polypropylene or nylon webbing, with the ends treated to prevent unraveling, Stainless steel hardware shall be used to securely attach strap to the insert.
4. The manhole insert shall have one or more vent holes or valves to release gases and allow water inflow at a rate no greater than 5 gallons per 24 hours. The valve shall be installed by the manufacturer at the factory.
5. There shall be a minimum 10-year warranty on the body of the dish and a 5-year warranty on all other parts of the insert.
6. The insert shall have proof of durability in traffic impact loads and shall have an Engineer certified proof test passing H-20 loading.

B. Stainless Steel

1. Stainless steel inserts shall be installed at locations with pipe size diameters of outfalls 15 inches or greater and as directed by the Engineer.
2. Insert shall be 304 stainless steel.
3. The manhole insert shall be as manufactured by Inflow Systems, Inc., Largo, Florida or approved equal.

PART 3 - EXECUTION

3.01 MANHOLES - GENERAL

- A. Perform excavation and prepare base area in accordance with Section 2300 - Excavation, Backfilling, and Compacting.
- B. Never install base in a water filled excavation.
- C. Place base per the Standard Detail Drawings and Section 3600 - Cast-In-Place Concrete. Extend base a minimum of six inches beyond finished sides of manhole.
- D. Extend all pipes entirely through the manhole wall so that a joint occurs no closer than 24 inches outside the manhole wall.

- E. Pipe installed for future extensions shall have one full joint of pipe installed.
- F. After manhole is constructed, wait no less than 48 hours, then backfill per Section 2300 - Excavation, Backfilling, and Compacting.

3.02 CAST-IN-PLACE MANHOLES

- A. Dimension and layout: Per City of Fayetteville Detail Drawings and Tables. The top section or cone must be concentric with the barrel unless otherwise noted.
- B. The frame shall be set in accordance with City of Fayetteville Details. The frame shall be installed to match the slope of paved areas.
- C. Install rubber waterstop gaskets in the walls around all pipes.
- D. Interior finish: Smooth, free of fins or sharp edges.
- E. Flow channels shall be shaped and formed in each manhole to provide a smooth transition of flow from all inlets to the outlet. The bench wall shall be formed from the center of the manhole to the outlet pipe in the shape of a "U" as shown in the Standard Details.
- F. Care should be taken to prevent the end of the pipe from deflecting, due to loads imposed by the weight of the concrete.
- G. Construction joints on manholes of excessive depth shall be connected with reinforcement approved by the Engineer.

3.03 PRECAST MANHOLES

- A. Dimension and layout: Per City of Fayetteville Detail Drawings. The top section or cone must be concentric with the barrel unless otherwise noted.
- B. The bottom section for pre-cast manholes shall be manufactured as an integral part of the manhole base slab.
- C. Install remaining sections in a truly vertical plane.
- D. The frame shall be set in accordance with City of Fayetteville Details. The frame shall be installed to match the slope of paved areas.
- E. Fill space between pipe and periphery of cutout on the interior of the manhole with non-shrink grout from the bottom of the invert to the spring line of the sewer pipe (1/2 pipe depth).
- F. Grout joints between sections, interior only.

- G. Interior finish: smooth, free of fins or sharp edges.
- H. Flow channels shall be shaped and formed in each manhole to provide a smooth transition of flow from all inlets to the outlet. The bench wall shall be formed from the center of the manhole to the outlet pipe in the shape of a "U" as shown in the Standard Details.
- I. Grout and/or plug lifting holes for manholes.
- J. All manhole joints shall be sealed with an external joint wrap material.

3.04 DROP MANHOLES

- A. Install a drop manhole when the vertical difference between the pipe entering and leaving the manhole exceeds two (2) feet.
- B. Construct manhole base, barrel, and top per the requirements for cast-in-place or pre-cast manholes.
- C. Construct drop of PVC pipe and fittings per Standard Details.
- D. Encase the pipe and fittings in Class A or B concrete as per Standard Details.

3.05 MANHOLE FRAME AND COVER

- A. Set the manhole frame for Cast-In-Place manholes in Class B concrete as shown on the Standard Details as an integral part of the manhole construction.
- B. Set manhole frame and cover top level and to the elevation shown on the Drawings. In public rights-of-way, set the ring and cover flush with pavements, sidewalks, or other paved surfaced areas.

3.06 MANHOLE INVERT

- A. Invert depth at the flow line: the same as the pipe diameter.
- B. In curved inverts, make curves with the longest possible radius to facilitate smooth flow and the insertion of cleaning and televising equipment.
- C. Flow channels shall be shaped and formed in each manhole to provide a smooth transition of flow from all inlets to the outlet. The bench wall shall be formed from the center of the manhole to the outlet pipe in the shape of a "U" as shown in the Standard Details.
- D. Invert materials and finish: Class B Concrete, smooth finish.

- E. Invert grade: Constant, smooth grade; no offsets.
- F. Bench: Slope grout upward from the edge of the invert to the manhole wall.
- G. Form a flow channel in the bench for any services stubbed into manhole. Form invert and finish per above.
- H. Cut the upper half of any pipe extending inside the manhole wall flush with the wall. Smooth rough edges with grout.

3.07 MANHOLE REPAIRS

- A. Make all repairs in accordance with these specifications.
- B. Use manhole grout in patching around new taps.
- C. Plaster all brickwork with mortar.

3.08 MANHOLE ADJUSTMENTS

- A. Manhole riser rings may be used to raise manhole covers to grade.
- B. Manhole riser rings shall be sealed with Adeka P-201 or Manus-Bond 75AM to create a water tight seal.
- C. Adjustments greater than 6 inches will require grade adjustment rings in accordance with the details.
- D. The exterior surfaces of the frame base, and four inches below the top of the manhole cone shall be cleaned with a wire brush and then waterproofed with trowelable bitumastic gasket material, Trowelable EZ-STIK #3 as manufactured by Press-Seal Gasket Corporation, 6-inch wide butyl external joint wrap material, or equal, in accordance with the manufacturer's specifications. A protective polyethylene cover shall be placed over the trowelable waterproofing material when backfilling, following sealing of the frame to the manhole.
- E. The throat section height shall not exceed 18 inches. The throat section shall be defined as the distance from the bottom of the integral cast manhole ring to the top of the manhole cover.

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END OF SECTION 3300

SECTION 3400

STEEL ENCASEMENT PIPE

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide encasement pipe jacked through bored tunnel for crossing of utility pipe lines under roadways where shown on the Drawings.
- B. Provide encasement pipe by open cut construction where shown on the Drawings.
- C. Pulling or jacking carrier pipe through encasement pipe.
- D. Providing synthetic end seals at ends of encasement pipe.

1.02 RELATED WORK

- A. Section 3100 – Installation of Sewer Pipe, Fittings, and Materials
- B. Section 4100 – Installation of Water Pipe, Fittings, and Materials

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A139 Specification for Electric-Fusion (Arc) - Welded Steel Pipe (sizes 4" and over).
 - 2. ASTM A211 Specifications for Spiral-welded Steel or Iron Pipe.
- B. American Welding Society (AWS):
 - 1. AWS D1.1 Structural Welding Code.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Encasement pipe: Smooth wall steel pipe conforming to ASTM A-53 / ASTM A283 / ASTM A-135, Grade B, CW, physical tests only (no hydrostatic test required). The pipe shall have beveled ends prepared for welded joints. The pipe steel shall have a minimum yield strength of 35,000 psi.
- B. Welding materials: Type required for materials being welded and conforming to applicable AWS Specifications.

- C. Grout: Cementitious grout shall consist of a preblend of lightweight aggregate, cement, fly ash and admix to prevent segregation and promote expansion upon setting. Loose bulk density for the dry mix materials shall be 30 to 35 pounds per cubic foot. Grout shall equal or exceed Strong-Seal Grout 250 - Product Code 2133 and shall be packaged in 2 cubic foot bags.
- D. Flowable Fill: Flowable fill shall conform to Section 206 – Flowable Select Material of the Arkansas State Highway and Transportation Department’s Standard Specifications for Highway Construction, latest edition.
- E. Casing Spacers: Shall be stainless steel, Cascade Model CCS as manufactured by Cascade Waterworks Mfg. Co., or approved equal.
- F. Casing End Seals: Casing end seals shall be one-piece and be of the pull-over type construction. Overlapping style end seals are not permitted. Casing end seals shall be of a synthetic material that is designed for the specific application. Casing end seals shall be secured to the encasement pipe and the carrier pipe with stainless steel bands. Casing end seals shall be Cascade Model CCES, or approved equal.
- G. Polyethylene Encasement: Polyethylene encasement shall be in conformance to ANSI/AWWA C105/A21.5, latest revision.

2.02 MINIMUM THICKNESS

- A. The encasement pipe shall be capable of supporting all traffic and earth loads. The Contractor shall submit design calculations supporting the selection of the encasement pipe thickness used.
- B. Minimum thickness for encasement shall be as follows:

<u>Diameter of Casing Pipe</u>	<u>Minimum Thickness</u>
20" OR LESS	.250"
24" – 30"	.375"
36"	.500"
48" – 60"	.625"
72"	.750"

Sizes not listed above shall be determined on an as-needed basis by the City.

- C. When boring under railroad right-of-way, minimum thickness shall be determined by railroad standards.

2.03 MINIMUM DIAMETER

- A. The minimum diameter for encasement pipe shall be such that the carrier pipe, along with casing spacers and joint restraints, will not bind against the inside of the encasement pipe during installation. The minimum diameter of encasement pipe shall be as follows:

<u>Diameter of Carrier Pipe</u>	<u>Diameter of Encasement</u>
2"	5"
3"	6"
4"	8"
6"	12"
8"	16"
10"	20"
12"	24"
14" – 16"	30"
18" – 20"	36"
24"	42"
30"	48"
36"	54"
42"	60"
48"	72"

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Highway Bore: Do not set up equipment or begin excavating pit on state highway without permission of Arkansas Highway and Transportation Department District Engineer or his authorized representative.
- B. Railroad Bore: Do not set up equipment or begin excavating pit on or near railroad property without permission of the respective railroad company.
- C. Highway and railroad permits will be obtained by the City. Contractor shall coordinate with City on obtaining Right-of-way permit from railroad and shall conform to all requirements there in.

3.02 INSTALLATION, ENCASEMENT PIPE

- A. General: Install encasement pipe at grade and alignment shown on Drawing. Allow for height of casement spacers when establishing grade for gravity line encasement pipe. Refer to Standard Details.

B. Bores:

1. Excavate pits and trenches required at each side of crossing to minimum width and length necessary for boring and jacking operation and carrier pipe installation.
2. Carefully set steel guide rails in pit to attain specified grade and alignment.
3. Keep pit pumped free of standing water. Maintain pit bottom to provide stable base for rails and equipment and firm footing for workmen. Granular material used in bottom of pit will not be paid for as "Additional Trench Bedding".
4. Provide temporary sheeting and bracing as necessary to prevent earth slides.
5. Bore tunnel and simultaneously jack encasement pipe forward one section at a time. Connect sections by full penetration butt welding performed in accordance with AWS D1.1.
6. Remove excavated soil from boring operation as it enters pit and dispose of it offsite.
7. Voids between the encasement pipe and the surrounding soil shall be pressure filled with grout.
8. Cathodic protection shall be installed on the steel encasement pipe. Use 17# HP magnesium anodes bonded to the steel encasement pipe.
9. End seal shall be installed after the carrier pipe has been installed.

C. Open Cut:

1. Excavate trench as required.
2. Steel encasement pipe shall be installed, bedded, and backfilled the same as ductile iron pipe.
3. Steel encasement pipe shall be double poly wrapped.
4. End seal shall be installed after the carrier pipe has been installed.

3.03 INSTALLATION, CARRIER PIPE

- A. Joint pipe as specified in Section 3100 or 4100. Pull or jack carrier pipe through encasement pipe. Do not allow cables or jacks to be in direct contact with carrier pipe while pulling or jacking pipe. Use timber or padded steel member.
- B. A minimum of three casing spacers shall be installed on pipe up to 20-foot pipe joints.
- C. All carrier pipe installed through the encasement shall be fully restrained. **Over-belling of the carrier pipe shall be prevented.**

3.04 BACKFILL

- A. Prior to backfill, seal ends of encasement pipe with and end seal as shown in the Standard Details.
- B. Use material excavated from pit.
- C. Backfill against ends of encasement pipe.
- D. Backfill pit and carrier pipe in same manner as specified in Section 2300 – Excavation, Backfilling, and Compacting.

3.05 CLEANUP

- A. Clean up ground surface around work area in same manner as specified for line work in Section 2300 - Excavation, Backfilling and Compacting.

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END OF SECTION 3400

SECTION 3500

SEWER PUMP STATIONS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. This Section pertains to the requirements for the design and construction of submersible type lift stations, which are the primary type constructed as part of private development. Their design and approval will be handled on a case-by-case basis.
- B. A registered Civil Engineer shall seal the civil portion of the drawings. A registered Electrical Engineer shall seal the electrical portion of the drawings. All engineers shall be registered in the State of Arkansas.
- C. Pump stations meeting or exceeding the requirements set herein will be approved. Any proposed alteration of the pump station dimensions, equipment, controls, etc. from the standards set forth herein will be approved only upon the submittal of plans and specifications of the proposed changes to the City, and upon the City's written approval.
- D. Pump Stations, in general, shall be submersible type including a minimum of two (2) pumps and motors of minimum pumping capacity of 100 gpm under site operating conditions, wet basin, separate valve pit, valves, piping, hatches, guide rails, pump removal components, control center, level controls, remote monitor package, interconnecting electrical wiring, incoming power and telephone supply, and all other features regularly and normally required as a part of a complete and functional facility. All work shall be in accordance with site requirements, details in the Drawings, these Standards and the manufacturer's recommendations.
- E. All Pump Stations shall be designed for and operate on 480 V, three (3) phase power. No deviation from this requirement shall be permitted without the express prior written approval of the City.
- F. The station shall be equipped with a remote monitor capable of monitoring the status of the lift station and communicating with the City's existing SCADA system housed at the Noland WWTP. **This system shall be purchased and installed by the City at the developer's or contractor's expense.**
- G. All of the mechanical and electrical equipment shall be an integral package supplied by the pump manufacturer with local representation so as to provide undivided responsibility. The package shall be equal in construction and performance to Fairbanks Morse Pump equipment or Flygt Pump equipment and other specific requirements set forth herein and in the approved plans.

- H. The Contractor shall submit to the City for review and approval three (3) sets of shop drawings, detailed specifications, pump warranty, and performance characteristics for all of the equipment and fixtures to be furnished and installed. The Shop Drawings and equipment data shall be submitted with a cover letter, Contractor's stamp of approval, and Engineer's stamp of approval indicating that he has reviewed, checked, and approved the data submitted. The City will review the submittal and render a decision in writing as to the acceptability of the equipment. Without prior written City approval, the item of work may not be accepted.
- I. Any exceptions to this Standard or associated approved Plans shall be submitted in writing and clearly stated. The exceptions must be approved by the City prior to proceeding with the work.
- J. All mounting and fastening hardware shall be stainless steel.
- K. All components of the pump station that are exposed to weather shall be constructed of material that is resistant to corrosion and will not require surface protection throughout the expected life of the lift station. In general, these materials are stainless steel, aluminum, fiberglass reinforced polyester (FRP), and ultraviolet stabilized PVC.
- L. All valves and ductile iron fittings shall be epoxy coated inside and out. All ductile iron piping coming in contact with wastewater or installed in the wet well, dry well or valve pit shall be coated with epoxy inside and out. Acceptable interior epoxy for ductile iron pipe shall be Protecto 401, or approved equal. Acceptable field applied exterior coating of ductile iron pipe shall be Raven 405, or approved equal. All stainless steel hardware and accessories shall be protected from field applied coating of the epoxy.

1.02 PUMP STATION SITE

- A. The pump station site shall have minimum dimensions of 50' x 50' with a maximum cross slope of 5%. The site shall be an all-weather surface consisting of asphalt or concrete. Additional site area may be required depending on the diameter and depth of the wet well and other accessories. Final dimensions of the site shall be determined by the City Engineer.
- B. The City of Fayetteville must own the land, by deed and not by plat, on which sewer pump stations are located or anticipated to be constructed.
- C. The pump station shall be provided with an access drive to the nearest public road. The access drive shall be an all-weather surface with a stabilized gravel base and asphalt or concrete surface. If the slope is greater than 10%, the surface shall be constructed in such a way that the surface material cannot creep down slope. The drive shall enter the public road at a curb cut.

- D. The pump station site shall be secured by a minimum 6' high wooden fence. Posts shall be a minimum of 3" SCH 40 galvanized steel. Gate posts shall be a minimum of 4" SCH 40 galvanized steel. Rails shall be 16-gauge galvanized steel, 2" x 4" nominal dimensions. Pressure treated wood shall be installed in the rails to anchor the pickets. All pickets shall be constructed of cedar, and shall be a minimum of 1"x6"x6'. All hardware used to anchor the cedar pickets to the steel rails shall be designated for use with cedar. A 12' wide double gate with lockable hasp shall be provided. A 3' wide man gate with lockable hasp shall be provided.

1.03 OPERATING CONDITIONS

- A. The characteristics and operating conditions of the lift station and pumps shall be provided in detail as part of the ENGINEER'S design and submitted for approval to the City.
- B. Prior to installation the Contractor shall submit the following information for each pump to the City for review and approval:
1. Pump capacity in gallons per minute;
 2. Total dynamic head (TDH) and operating RPM; Use C=120 and C=140
 3. Motor horsepower;
 4. Motor rpm;
 5. Motor voltage, phase and cycle;
 6. Make and model number; and
 7. Pump curves for the pumps to be provided.
- C. Pump station acceptance will be based upon pump drawdown tests. The acceptable range is +10% and -5% of the reported pump capacity in GPM. Pump flows outside of this range will result in non-compliance of the standard and the pump station will not be accepted.

1.04 NOTES TO DESIGN ENGINEER

A. SIZING OF WET BASIN

1. The wetwell storage depth below the lowest inlet shall be a minimum of 5'-0" and shall also meet the following criteria:
 - a. All pumps OFF shall be set at the pump manufacturer's recommended level but no less than 1'-6" from the bottom of the wetwell.

- b. The distance between all pumps OFF and the lead pump ON shall be set to provide storage capacity equal to:

$$\frac{15 \times \text{RATED PUMP GPM}}{4}$$

4

(i.e. 15 minute cycle minimum)

- c. The lag pump ON shall be set a minimum of 6" above the lead pump ON and a minimum of 12" below the lowest inlet invert.
- d. The high water alarm float shall be set a minimum of 6" above the lag pump ON and minimum of 6" below the lowest inlet invert.
- e. All level control elevations shall be set below the lowest inlet invert.

1.05 SMALL DIAMETER PRESSURE SEWERS

- A. Small diameter pressure sewer systems incorporating the use of individual home grinder pump units will be allowed on a case-by-case basis subject to the written approval of the City of Fayetteville and the Arkansas Department of Health. In general, these systems shall only be considered in areas where the surrounding areas are currently served by sanitary sewers and the site can not be sewered by gravity.
- B. The maintenance of the grinder pump station and building force main to the point of connection with the collector force main shall be the responsibility of the home owner. The City shall only be responsible for the maintenance of the collector force main.

1.06 PUMP STATION WARRANTY

- A. Pump station warranty shall be two (2) years from the date of acceptance per City maintenance bond requirements.

PART 2 – PRODUCTS

2.01 PUMPING EQUIPMENT

- A. Pumps shall be of the submersible type for handling raw unscreened sewage. Pump volute, motor and seal housing are to be high quality gray cast iron. Impeller shall be either cast iron or cast bronze of a non-clog design capable of handling minimum three (3) inch sphere solids, fibrous material, heavy sludge, and other matter found in normal sewage applications. Impeller shall have pump-out vanes on the back shroud of the impeller to keep pumped material away from

the seal area and increase operating life. Impeller shall be either slip fit or taper fit with key to securely lock the impeller to the driving shaft. The pump volute shall be fit with a replaceable bronze wear ring to minimize wear on the impeller and help achieve longer balanced operating life. All fasteners shall be of stainless steel.

- B. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Sealing shall be accomplished when metal-to-metal contact is made, resulting in controlled compression of the rubber O-rings without requirement of a specific torque limit.
- C. The pump shall be provided with a mechanical rotating shaft seal system running in an oil reservoir having separate, constantly lubricated lapped seal faces. The lower seal unit between the pump and oil chamber shall consist of one (1) stationary seat and one (1) rotating ring held in place by its own spring. The lower seal shall be removable without disassembling the seal chamber. The upper seal between the motor and the seal chamber shall be of the same design with its own separate spring system. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable. The shaft sealing system shall be capable of operating submerged to pressures equivalent to two hundred (200) feet. No seal damage shall result from operating the pump unit out of its liquid environment. The seal system shall not rely upon the pumped media for lubrication.
- D. The seal chamber shall also be equipped with a seal failure sensor probe which will sense water intrusion through the lower seal. This sensor is to be connected to an alarm in the control panel to indicate lower seal failure.
- E. The stator winding, rotor and bearings are to be mounted in a sealed submersible type housing. Insulation utilized in the stator windings shall be Class F with maximum temperature capability of 155EC. Motor housing shall be filled with a high dielectric oil to give superior heat transfer and allow the bearing to run in a clean, well lubricated environment; or the housing shall be air filled with grease lubricated bearings. The pump and motor are to be specifically designed so that they may be operated partially or completely submerged in the liquid being pumped. The pump should not require cooling water jackets. Stator shall be securely held in place with a removable end ring and threaded fasteners so that it may be easily removed in the field without use of heat or press. Shaft shall be of stainless steel and supported by ball bearings. Motor shall be provided with heat sensing units attached to the motor windings which shall be connected to the control panel to shut down pump if overheating occurs.
- F. Pump motor cable and heat sensor/seal failure sensor cable shall be suitable for submersible pump applications and this shall be indicated by a code or legend permanently embossed on the cable. Cable sizing shall conform to NEC specifications for pump motors and shall be of adequate size to allow motor

voltage conversion without replacing the cable. Cable of the proper length shall be provided to eliminate need for splices or junction boxes between pump and "control center". The cable shall enter the motor through a cord cap assembly which is double sealed allowing disassembly and disconnect of the wires and the motor and still not damage the sealed characteristics of the motor housing. Each individual conductor shall be color coded in accordance with generally accepted industry standards. The color coding shall designate the application of the conductor.

- G. The pump mounting base shall include adjustable guide rail supports and a discharge connection with a one hundred twenty-five (125) pound standard flange. The base and the discharge piping shall be permanently mounted in place. The base plates shall be anchored in place utilizing epoxy type anchors with stainless steel studs and nuts as manufactured by HILTI Fasteners, Inc. or equal.
- H. A rail system shall be provided for easy removal of the pump and motor assembly for inspection and service. The system shall not require a man to enter the wetwell to remove the pump and motor assembly. Two (2) rails of two (2) inch stainless steel pipe shall be provided for each pump. The guide rails shall be positioned and supported by the pump mounting base. The guide rails shall be aligned vertically and supported at the top by attachment to the access hatch frame. One (1) intermediate guide rail support is required for each fifteen (15) feet of guide rail length for stainless steel pipe.
- I. The pumps shall be equipped with sliding brackets or rail guides. To insure easy removal of the pumps, the rail guides attached to each pump shall not encircle the rails. A stainless steel lifting chain or manufacturer's pump removal system (similar to the Flygt Lift) of adequate length for the basin depth shall be provided for each pump. Each pump shall be equipped with a permanent, stationary lifting handle with a minimum clearance of 12" between the top of pump and bottom of handle.
- J. The rails and the rail guides shall function to allow the complete weight of the pumping unit to be lifted on dead center without binding and stressing the pump housing. The rail system shall function to automatically align the pumping unit to the discharge connection by a simple downward movement of the pump. No twisting or angle approach will be considered acceptable. The actual sealing of the discharge interface may be of the metal-to-metal contact. No sealing gaskets will be permitted.
- K. Pump warranty shall be provided by the pump manufacturer and shall warrant the units being supplied to the Owner against defects in workmanship and materials for a period of five (5) years under normal use, operation and service. The warranty shall be in printed form and apply to all similar units. A copy of the warranty statement shall be submitted with the approval drawings.

2.02 BASIN, VALVE PIT AND ACCESSORIES

- A. The basin and valve pit are to be constructed of precast concrete meeting the requirements of ASTM C-478. Cast-in-place monolithic structures may be substituted with the prior written approval of the City. Minimum valve vault and wetwell diameter shall be 6'-0'. The actual arrangement of the structures are to be as shown in the approved Plans. The wetwell basin top shall be provided with a six (6) inch stainless steel vent having a downward pointing inlet and screen over the inlet opening.
- B. The basin, valve pit, flat tops, and base slabs are to be constructed of precast or cast-in-place reinforced concrete manhole sections conforming to ASTM C-478. All joints between precast sections shall be made with an approved rubber O-Ring in accordance with ASTM C-443 and a 1/2 inch diameter non-asphaltic mastic conforming to AASHTO M-198 and Federal Specification SS-521-A. All manhole joints shall be sealed with an external joint wrap material. Material shall be equal to Bidco Butyl Wrap as manufactured by NPC or Infi-Shield® Gator Wrap by Sealing Systems, Inc. In addition, the outside wall below grade is to be coated with bituminous waterproofing material. The top and bottom of the chambers shall be precast or may be poured in place concrete if approved by the City Engineer.
- C. The wetwell pump basin and the valve pit chamber shall be enclosed at grade level with a reinforced concrete pad rectangular in shape and extending a minimum of 1'-0' from the chambers outside dimension.
- D. **All concrete surfaces within the wet well shall be coated with one of the products listed below.** These products shall only be applied by personnel thoroughly familiar with handling of the coating material, and in accordance with the manufacturer's specifications, recommendations and requirements.
1. Raven Ultra High-Build Epoxy Coating, designated as Raven 405, with an average thickness of 100 mils and a minimum thickness of 80 mils.
 2. Warren Environmental Systems, designated as S-301, with an average thickness of 100 mils and a minimum thickness of 80 mils.
 3. All epoxies shall meet the following minimum requirements:

Flexural Strength	ASTM D790	6,000 psi
Compressive Strength	ASTM D695	8,000 psi
Tensile Strength	ASTM D638	4,000 psi
Tensile Elongation	ASTM D638	4%
Adhesion	ASTM D4541	Concrete Substrate Failure
- E. The pump supplier shall provide an aluminum two (2) door access hatch frame and door assembly to be installed in the concrete basin top. This door assembly

shall provide access for removal of the pumps and shall support the guide rails. The doors shall be provided with lifting handle, safety latch to hold door in the open position and a hasp suitable for padlock. The doors shall have a nonskid finish and be designed for light, medium, or heavy duty, depending on the location of the pumping station.

- F. An aluminum single door access hatch frame and door assembly similar to the one described above shall be provided for use as entry to the valve pit. Minimum opening for the valve box entry shall be thirty-six (36) inch by thirty-six (36) inch.
- G. A swing check valve with external swing arm and a full port (100% area) eccentric plug valve shall be installed in the valve pit in each pump's discharge piping. A minimum clearance of twelve (12) inches shall be allowed from the bottom of the valves to invert of the pit. A drain pipe and p-trap shall be installed to drain the valve pit back to the wet basin but not allow the wet basin liquid to enter the valve pit. In addition, a 1/2" NPT tap and ball valve shall be provided on the discharge side of the pumps past the valves to facilitate pressure readings for the pump discharge.
- H. All yard piping within the pump station site shall be centrifugally cast ductile iron and shall conform to ANSI Specifications A21.51 and AWWA C-151, latest revision and shall be Pressure Class 350, 300, 250, or 200 wall thickness dependent upon site conditions. All direct buried ductile iron pipe and fittings shall be double poly-wrapped.
- I. Force main pipe downstream of the pig launch structure shall be DIP or PVC in accordance with Section 3000. All force main pipe shall have tracer wire installed along its entire length. Gate valves (up to 10-inch) or full-port plug valves (12-inch) shall be installed along its length, not to exceed 1000' unless a variance is approved by the City for long force mains, and shall be marked sewer. An empty valve box shall be installed in the vicinity of the discharge manhole and at fittings that cause a change in direction where the tracer wire can be brought to grade for a point of connection to aid in tracing the force main. The valve box shall be marked sewer. A 2-inch SCH-40 PVC pipe shall be installed in the empty valve box. The pipe shall have a pipe marker label affixed and further labeled "No Valve, Tracer Wire Only." The force main shall have tape marked sewer wrapped around the pipe with complete revolutions not to exceed 6'. Tape marked sewer shall also be installed in the trench 18" above the top of the sewer force main.
- J. Sewer line markers shall be TriView Marking System by Rhino Marking and Protection Systems, Carsonite International Dual-Sided Utility Marker (CIB-380), or approved equal. All markers shall be installed according to the manufacturer's recommendations. The uppermost portion of the Carsonite marker shall be made of Visibility Enhancer (CVE-360), or approved equal and must be bolted to the

utility marker. TriView markers do not require visibility enhancers. The utility marker shall read as follows: "CAUTION, SEWER PIPELINE", "City of Fayetteville", and "Before Digging Call 1-800-482-8998". The label shall also include the official City Logo and be white in color with green and black lettering. The label shall be affixed to two sides of the marker. **An additional white 1" wide reflective tape (3M or equal) shall be placed around the full circumference of the top of the marker.** Concrete shall be placed 6-inches around and 1-foot deep around the base of each marker.

- K. All force mains shall be equipped with a pig launch within the pump station site. A fire hydrant is required to be located within 100' of the site to facilitate pigging of the force main.

2.03 GENERAL ELECTRICAL

- A. A single main fusible or breaker disconnect switch of adequate size to provide power for the "control center" and its related components shall be provided by the Contractor.
- B. The disconnect switch shall be housed in a NEMA 4X stainless steel enclosure with an external operation handle capable of being locked in the ON position.
- C. The pump station site shall include a GFI convenience outlet with 20 amp breaker and suitable transformer or power supply to provide 110 volt single phase power to the convenience outlet.
- D. A minimum four (4) inch PVC schedule 40 wall conduit shall be provided from the wetwell basin to the control center which will allow the pump power cables, sensor cables and level controls to be pulled through without difficulty and allow the use of one (1) piece cables from the pumps and level controls to the control center. The conduit shall be sealed at the control center to avoid entrance of sewer gases into the control panel.
- E. A minimum three-quarter (3/4) inch PVC schedule 40 wall conduit shall be provided from the valve vault to the control center for future remote monitoring of the swing check valves.
- F. All vertical conduit and transitions from horizontal to vertical runs shall be rigid metallic conduit. Horizontal, below grade, conduit runs may be either Schedule 40 PVC or rigid metallic conduit.

2.04 CONTROL CENTER

- A. The control center shall be built in a NEMA 4X stainless steel enclosure and shall be suitable for the specified horsepower and voltage for the pumping equipment. The outer door of the panel shall be hinged dead front with provisions for locking with a padlock. Inside shall be a separate hinged panel to protect all electrical

components. H-O-A switches, run lights, circuit breakers, etc. shall be mounted such that only the faces protrude through the inside swing panel and no wiring is connected to the back side of the inside swing panel. The control center shall be located so as to provide safe access to the panel while wetwell hatch doors are opened, and shall be positioned so as not to be between the access drive and the wetwell.

- B. A circuit breaker and magnetic starter with three (3) leg overload protection and manual reset shall be provided for each pump. Starters shall have auxiliary contacts to operate both pumps on override condition. A separate circuit breaker shall be supplied for power to the control circuit. The control center shall include an extra circuit breaker of adequate size to provide 115 volt, single phase power for the remote monitor panel. The control center shall include a control voltage transformer to reduce supply voltage 115 volt, the float circuit and associated relays which shall be provided with 24 volt control voltage. An alternating relay shall be provided to alternate pumps on each successive cycle of operation. A green run light and H-O-A switch shall be provided for each pump. A terminal strip shall be provided to make field connections of pump power leads, level control, seal sensor leads, heat sensor leads, and remote monitor panel interconnections.
- C. A time delay relay shall be provided to delay start of second pump should power outage occur.
- D. The control center shall incorporate connections for heat sensors which are installed in the pumps. The connection shall disconnect the starter upon high temperature signal and will automatically reconnect when condition has been corrected.
- E. The control center shall incorporate connections for seal failure sensors which are installed in the pumps. The panel will have a seal failure alarm light for each pump. This alarm indicates failure of the lower mechanical seal in the pump. This will be an alarm light only and will not shut down the pump.
- F. The control center shall include an hour meter for each pump to register the elapsed operating time of each pump.
- G. The control center shall have a high water alarm built into the main enclosure. The high water alarm shall consist of a flashing alarm light with red Lexan plastic cover or red glass globe with metal guard mounted on top of the enclosure such that it is visible from all directions. An alarm horn shall be mounted on the side of the enclosure. A push to test horn and light button as well as a push to silence horn button shall be provided and mounted on the side of the enclosure.
- H. The control center shall include a condensate heater to protect against condensation inside the enclosure. The heater shall be placed so as not to damage any other component or wiring in the control center.

- I. The control center shall include lightning protection and a phase monitor relay to shut down the control circuit and protect the equipment due to loss of phase or phase reversal. The three (3) phase sequence voltage relay shall be of the 8-pin connector type.
- J. The control center shall incorporate an alternator selector switch to allow selection of automatic alternation or manual selection of the lead pump.
- K. The control center shall be suitable for connection to a remote monitor package as described in the section titled "Remote Monitor Package". The main control must include the following interconnection capability:
 - 1. Circuit breaker to power remote monitor panel as described above.
 - 2. Relay contact to signal high water alarm.
 - 3. Relay contact to signal tripping of the overload of any of the pumps.
 - 4. Relay contact to transmit signal of seal failure or heat sensor trip of any of the pumps.
 - 5. Relay contact to indicate phase failure
 - 6. Relay contact to signal pump motor starts, i.e. ON or OFF
- L. All component of the control center shall be American made and available from local sources. In particular, items such as circuit breakers, overload protection, relays, etc. shall be available and in stock by local sources.
- M. Pump control shall be achieved by the use of a bubbler system. The bubbler system shall include integral air supply generated by an on-site air compressor unit, flow regulator, pressure sensing equipment for level indication and pump control, stainless steel tubing, bypass/blowdown valve for cleaning bubbler tube, and all other material, equipment, and labor required for a complete, tested, and accepted bubbler control system. The Controller shall be model SC2000 as manufactured by Motor Protection Electronics of Apopka, Florida (407) 299-3825, or approved equal by the City of Fayetteville.
- N. In order to maintain unit responsibility and warranty on the pumping equipment and control center, the control center must be accepted in writing by the pump manufacturer as suitable for operation with the pumping equipment.

2.05 SCADA REMOTE MONITOR PACKAGE

- A. The station shall be equipped with a remote monitor capable of monitoring the status of the lift station and communicating with the City's existing SCADA system housed at the Noland WWTP. **This system shall be purchased and installed by the City at the developer's or contractor's expense.**

2.06 SPARE PARTS

- A. The Contractor shall supply one set of spare parts for each pump for each station, including at a minimum the following:
 - 1. Impeller;
 - 2. Upper seal assembly;
 - 3. Lower seal assembly;
 - 4. Upper bearing assembly;
 - 5. Lower bearing assembly;
 - 6. Wear rings; and
 - 7. O-Rings and gaskets (two (2) sets).

2.07 OPERATION AND MAINTENANCE MANUALS

- A. Three (3) operation and maintenance manuals shall be submitted to the City
- B. Manuals shall include, at a minimum:
 - 1. Operation instructions;
 - 2. Maintenance instructions;
 - 3. Recommended spare parts list;
 - 4. Lubrication schedules;
 - 5. Structural diagrams;
 - 6. As-built wiring diagrams; and
 - 7. Bill of materials.
 - 8. Copy of design engineer's pump operating point calculations, population assumptions, average daily flow, and peaking factor

2.08 GENERATOR SET

- A. GENERAL
 - 1. The pump station shall include an on-site backup power generator. The generator and lift station combination must include switching and control gear such that the backup power source is activated automatically without human action. The fuel source shall be natural gas. In the event that natural gas is unavailable, propane shall be used with a minimum tank sized to run all pumps at full load for 48 hours. The generator must be capable of operating the lift station at full capacity, i.e., with the largest pumps, impellers, and motors, and the greatest number of pumps, that the lift station can physically contain, with all of the above operating at full speed simultaneously.

B. EQUIPMENT

1. The generator set shall be minimally rated at the kW rating as indicated on the drawings when operating at 277/480 volts, 0.8 lagging power factor. The generator set shall be capable of this rating while operating in an ambient temperature condition of 122°F (50°C).
2. The generator set shall be capable of starting motor loads as indicated on the drawings along with a minimum station load of 5 kW and a maximum voltage dip of 25%.
3. The engine shall deliver power at a governed speed of 1800 rpm.
4. Sound Attenuated Weather Protective Enclosure
 - a. Manufacturer shall have a minimum five years experience in the design and construction of weather-protected generator-set enclosures.
 - b. The enclosure panels shall be assembled with modular, bolt-together construction.
 - c. Enclosure shall include the following features:
 - 1) Foam insulation on all interior surfaces
 - 2) Sound level not to exceed 68 dba within 7 meters of enclosure surface in any direction
 - 3) All exterior and interior surfaces finished with baked-on powder-coat
 - 4) Bottom flange with multiple mounting holes
 - 5) Stainless steel door hardware and lift-off hinges
 - 6) Lockable doors
 - 7) Gasketed access doors
5. Automatic Transfer Switch (ATS)
 - a. It is the intent of this specification to secure automatic transfer switches that have been prototype tested, factory built, production tested, and site tested, together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein. Automatic transfer switches with number of poles, voltage and current ratings as shown on the plans shall be provided. Each ATS shall consist of an inherently double-throw power transfer switch unit and a control module interconnected to provide complete automatic operation. All equipment shall be new and of current production by an international firm which manufactures the generator, controls, and transfer switch. The company selected will assemble the standby generator set and

system as a matched unit so that there is one-source responsibility for warranty, parts and service through a local representative with factory-trained personnel.

- b. ATS shall be sized as indicated on the drawings, 480 volt, 3 phase, 4 wire, 3 pole with solid neutral.
- 6. Submit motor starting calculations and generator sizing calculations for approval.
- 7. The generator set shall provide the following status signals to the SCADA package:
 - a. Generator status
 - b. Generator general alarm

PART 3 – EXECUTION

3.01 SYSTEM OPERATION

- A. On wet well level rise, the lead pump shall start at the lead pump ON elevation. With the lead pump operating, the wet well level shall lower to all pumps OFF and turn off the pump. The alternating relay in the control center shall index on stopping of the pump so that the lag pump will start on the next operation.
- B. If the wet well level continues to rise when lead pump is operating, the override switch shall energize and start the lag pump. Both lead and lag pumps shall operate together until low level switch turns off both pumps. If level continues to rise when both pumps are operating, alarm level switch shall energize and signal the alarm.
- C. If one pump should fail for any reason, the second pump shall operate on the override switch.
- D. If the pumps fail to turn off for any reason after receiving the signal for all pumps OFF, a low level alarm shall signal.
- E. All level controls shall be adjustable for level setting from the surface.

END OF SECTION 3500

SECTION 3600

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers cast-in-place concrete materials, reinforcing steel, forms, and finishing in conjunction with water and sewer construction.
- B. Use Class B Concrete for all structures.
- C. Use Class A Concrete for bedding and blocking only.

1.02 RELATED WORK

- A. Section 2300 – Excavation, Backfilling, and Compacting
- B. Section 3100 – Installation of Sewer Pipe, Fittings, and Materials
- C. Section 3200 – Installation of Sewer Service Lines
- D. Section 3300 – Manholes
- E. Section 4100 – Installation of Water Lines and Service Lines
- F. Section 6000 - Pavement Repair

1.03 QUALITY ASSURANCE

- A. Not used.

1.04 SUBMITTALS

- A. Submit mix design, equipment details, and vendor name for field batched concrete.

1.05 REFERENCES

- A. Not used.

PART 2 - PRODUCTS

2.01 CONCRETE

- A. Concrete: composed of Portland Cement; fine and coarse aggregate; water; and, an air entraining agent. Provide either Class A concrete or Class B concrete as described below.
- B. For Class A and Class B concrete use ready-mixed concrete; conform to ASTM C 94, latest edition; deliver and place within one hour after all materials have been placed in the mixing drum.
- C. The concrete mix shall be designed so that the proportions will produce results that will meet the requirements of Class A or Class B concrete. Proportion components, except water, by weight. Water may be measured by volume. One sack of Portland Cement consists of one cubic foot or 94 pounds. Proportion components to meet these requirements:
 - 1. Class A Concrete:
 - a. Maximum net water/cement ratio = 0.49
 - b. Slump range: 1 - 4 inches
 - c. Minimum 28 day compressive strength: 3,000 PSI
 - 2. Class B Concrete:
 - a. Maximum net water/cement ratio = 0.49
 - b. Slump range: 1 - 4 inches
 - c. Minimum 28 day compressive strength: 4,000 PSI
 - d. Air Content: 4 - 7
- D. Before beginning any concrete work, the Contractor shall have the concrete mix designed and the ingredients selected and proportioned by an approved independent testing laboratory meeting the requirements of ASTM E 329. Certified copies of all laboratory trial mix reports shall be sent to the Engineer from the testing laboratory for review. **Do not place concrete prior to the Engineer's review and acceptance in writing of the concrete mix design.**
- E. Cement: Portland Cement conforming to AASHTO M 85, Type I. Use Type III cement (high early strength) only if approved by the Engineer.
- F. Fly ash: Fly ash may be used as a partial cement replacement **not exceeding 10% by weight of the cement** when approved by the City. When fly ash is used, the total weight of both cement and fly ash will be used in design calculations.

- G. Water: potable water free from injurious amounts of acids, alkalis, oils, sewage, vegetable matter and dirt.
- H. Air entraining agent: use in all Class B concrete as required; conform to AASHTO M 154; add to the mixing water in solution; proportion to provide four (4) to seven (7) percent air in the concrete.
- I. Fine aggregate: clean, hard, durable particles of natural sand free from injurious amounts of organic impurities; conform to the gradation requirements of AASHTO T 27.
- J. Coarse aggregate: clean, hard and durable crushed stone or washed gravel; reasonably well graded from course to fine; per AASHTO T 27.

2.02 REINFORCING STEEL

- A. Steel bars: deformed, conforming to ASTM A 615 or A 617.
- B. Steel wire: conform to ASTM A 82, Cold-Drawn Steel Wire for Concrete Reinforcement.
- C. Wire mesh: conform to ASTM A 185; gauge and mesh per plans.
- D. Submit reinforcing steel bars shop drawings for approval.
- E. All steel reinforcement: free from rust, scale, mortar, dirt, or other objectionable coatings.

PART 3 - EXECUTION

- A. Perform excavation per Section 2300 - Excavation, Backfilling, and Compacting.
- B. Build forms neat, square, and flat so concrete will have smooth finish when forms are pulled. Construct forms to provide finished concrete to dimensions shown on plans.
- C. Place reinforcing steel accurately in accordance with details shown on the plans and properly secure in position.
- D. Concrete shall not be placed when the temperature is below 40° F and dropping or below 35° F if the temperature is rising, unless approved by the Engineer.
- E. Vibrate all structural concrete as it is placed using internal vibrators capable of transmitting vibration to the concrete at frequencies not less than 4,500 impulses per minute. Do not use form vibrators. Limit vibration to provide satisfactory consolidation without causing segregation. Do not insert vibrator more than six

(6) inches into the lower courses previously vibrated. Use vibrators in a substantially vertical position; insert at uniformly spaced points no farther apart than the visible effectiveness of the vibrator.

- F. Allow concrete to cure for at least 48 hours before stripping forms. If concrete is in a structural member, do not remove forms until the concrete can withstand safely all superimposed loads.
- G. On all exposed surfaces, remove all fins and projections so the surface is smooth. Cut out and fill with grout any honeycombed areas. Extensive honeycombing is not allowable.

END OF SECTION 3600

SECTION 4000

WATER PIPE, FITTINGS, AND MATERIALS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the manufacture, transportation, and storage of pipe, pipe joints, fire hydrants, fittings, and other materials for water lines and service lines.
- B. Use only materials approved by the City of Fayetteville.

1.02 RELATED WORK

- A. Section 3600 – Cast-In-Place Concrete
- B. Section 4100 – Installation of Water Pipe, Fittings, and Materials
- C. Section 5300 - Inspection and Testing of Water Lines and Service Lines

1.03 SUBMITTALS

- A. Use of materials other than those specifically listed below is prohibited.
- B. Submit the manufacturer's certificate that the materials meet with these Specification requirements including material testing requirements.

1.04 LEAD-FREE BRASS

- A. **All brass shall be manufactured in accordance with the Safe Drinking Water Act as amended to be LEAD-FREE brass (< 0.25% Pb).**

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE FOR WATER LINES

- A. PVC pipe less than 4 inches in size shall be manufactured in accordance with ASTM D-2241 and shall be SDR 13.5.
- B. PVC pipe 4 inches through 12 inches in size shall be manufactured in accordance with AWWA C900, latest revision, and shall be DR 14.

- C. PVC pipe, couplings, and fabricated fittings shall be made from virgin PVC resin that has been compounded to provide physical and chemical properties that equal or exceed cell class 12454 as defined in ASTM D1784, latest revision. Clean, reworked material generated from the manufacturer's own production shall be acceptable as long as the pipe produced meets all the requirements of the Specifications.
- D. Joints for PVC pipe shall conform to ASTM Specification D-3139, latest revision.
- E. Nominal laying length shall be 20 feet. **Minimum length of a cut section of pipe shall be 5 feet.**
- F. Marking on pipe and shall include the following and shall be applied at intervals of not more than 5 feet.
 - 1. Nominal size in inches and OD base (for example, 8 DI).
 - 2. PVC.
 - 3. Dimension ratio (for example, DR 14).
 - 4. AWWA pressure class (for example, PC 305).
 - 5. Test pressure for hydrotested pipe (for example, T330) or if not tested, "NOT HYDROSTATIC PROOF TESTED."
 - 6. AWWA designation number for this standard (ANSI/AWWA C900, or ASTM D-2241).
 - 7. Manufacturer's name or trademark and production run record or lot code.
 - 8. Seal (mark) of the testing agency verifying the suitability of the pipe material for potable-water service.

2.02 DUCTILE IRON PIPE FOR WATER LINES

- A. Ductile Iron Pipe shall conform to the requirements of "Ductile-Iron Pipe, Centrifugally Cast" AWWA Standard C151/A21.51, latest revision.
- B. Ductile iron pipe shall be designed in accordance with the requirements of "Thickness Design of Ductile-Iron Pipe", ANSI/AWWA C150/A21.50, latest revision. Minimum pressure class shall be 250 psi.
- C. Joint connections, pipe and fittings (latest revision):
 - 1. Push on and mechanical rubber gasket joints: ANSI/AWWA C111/A21.11.
 - 2. Flanged: ANSI/AWWA C115/A21.15, ANSI B16.1.
 - 3. Grooved and shouldered ANSI/AWWA C606.
- D. Nominal laying length shall be 20 feet. **Minimum length of a cut section of pipe shall be 5 feet.**

- E. **Weights and Marking:** Weights of pipe and fittings shall conform strictly to the requirements of ANSI Specifications. The weight, class or nominal thickness, and casting period shall be shown on each pipe. The manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "DUCTILE" shall be cast or metal stamped on the pipe, and letters and numerals on pipe sizes 14 in. (356 mm) and larger shall be not less than 1/ 2 in. (13 mm) in height.
- F. **Corrosion Control**
 - 1. Outside coating shall be an asphaltic coating approximately 1 mil thick. The coating shall be applied to the outside of all pipe.
 - 2. The interior lining for use under normal conditions shall be a cement–mortar lining and seal coat in accordance with the latest revision of ANSI/AWWA C104/A21.4, latest revision and NSF 61.
 - 3. Polyethylene wrap in tube or sheet form conforming to the requirements of ANSI/AWWA C105/A21.5, latest revision. The pipe shall be double wrapped.

2.03 POLYETHYLENE (PE) PRESSURE PIPE AND TUBING

- A. PE pipe 3/4 inches through 2 inches in size shall be manufactured in accordance with AWWA C901, latest revision, and shall be SDR 9. Color shall be black.
- B. PE pipe shall be made from virgin PE material compounds that meet ASTM D3350 requirements. The pipe shall have a standard designation code of PE3608. Clean, reworked material generated from the manufacturer's own production shall be acceptable as long as the pipe produced meets all the requirements of the Specifications.
- C. Marking on pipe and tubing shall include the following and shall be applied at intervals of not more than 5 ft.
 - 1. Nominal size and diameter base (e.g., ID, OD, IPS, or CTS).
 - 2. SDR, SDR, or minimum wall thickness.
 - 3. The manufacturer's name or trademark.
 - 4. The material designation code (e.g., PE 3608)
 - 5. The AWWA pressure class (e.g., PC 200)
 - 6. The AWWA designation number for this standard (e.g., AWWA C901).
 - 7. The manufacturer's production (lot) code that includes information such as resin source, manufacturing location, extrusion outlet (line), and manufacturing date.
 - 8. If not included in the manufacturer's production code, the manufacturing date, including day, month, and year in a recognized standard format. The date format should be readily recognized as a date.
 - 9. The seal or mark of the testing agency that certifies the material.

2.04 STAINLESS STEEL INSERTS FOR POLYETHEYLENE TUBING

- A. Inserts for PE tubing shall be solid tubular 304 stainless steel, dimpled, and flanged to retain placement within PE tubing. Inserts shall be used on all PE tubing connections. The SS steel inserts shall be specifically sized (diameter and length) for the PE tubing that is being used with.

2.05 POLYETHYLENE ENCASEMENT (PIPE WRAP)

- A. Polyethylene encasement shall be in conformance to ANSI/AWWA C105/A21.5, latest revision. The virgin linear low-density polyethylene film shall have a minimum normal thickness of .008 inches (8 mils), and shall be provided in either flat tube or sheet form.
- B. The color shall be black with nominal 2% carbon black UV inhibitor and printed per the AWWA C105 standard.
- C. Tape for field taping of polywrapped pipe, fittings, etc. or field repair of missing polyethylene encasement material shall be Polyken #900, Scotchrap #50 or equal, at least 2-inches wide, and installed as per the Polyethylene Encasement Installation Guide published by DIPRA. **Duct Tape is not permitted.**
- D. **All buried iron pipe, valves, and fittings shall be double wrapped.**

2.06 DUCTILE IRON FITTINGS

- A. All ductile iron fittings shall conform to the requirements of ANSI/AWWA C153/A21.53, latest revision, for Ductile Iron Compact Fittings. All fittings shall be MJ x MJ. **All fittings shall be fusion-bonded epoxy coated inside and outside in accordance with ANSI/AWWA C116/A21.16.**
- B. Solid sleeves shall be long bodied only.

2.07 FOSTER ADAPTERS

- A. Compact MJ restraints shall be Foster Adapter by Infact Corporation.

2.08 SWIVEL ADAPTERS AND HYDRANT TEES

- A. Swivel adapters and hydrant tees shall be designed for a working pressure of at least 250-psi and to fit standard mechanical joint fittings (AWWA C111). One end of the swivel adapter and the branch of the hydrant tee shall be provided with a gland that may be rotated 360 degrees on the fitting. Lengths of swivel adapters shall be as specified.

2.09 MECHANICAL JOINT RETAINER GLANDS

- A. Restraint devices for mechanical joint fittings and appurtenances for nominal pipe sizes 3-inch through 48-inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
- B. Mechanical joint retainer glands shall be made from ductile iron and shall be designed for a working pressure of at least 350-psi for 3-inch through 16-inch ductile iron pipe, at least 305-psi for 3-inch through 12-inch PVC, and at least 250-psi for 18-inch through 48-inch ductile iron pipe.
- C. Retainer glands shall have an approved coating system for corrosion resistance equivalent to MEGA-BOND® and manufacturing traceability. Retainer glands shall be manufactured by EBAA Iron, Inc., Smith-Blair, Inc., or Star Pipe Products (USA only).
 - 1. Retainer glands for pipe sizes 3-inch through 12-inch shall be manufactured by EBAA Iron, Inc., Smith-Blair, Inc., or Star Pipe Products (USA only).
 - 2. Retainer glands for pipe sizes greater than 12-inches shall be manufactured by EBAA Iron, Inc., or Star Pipe Products (USA only).

2.10 PIPE RESTRAINTS

- A. Devices for the prevention of “over-insertion” of AWWA C900 PVC sizes 4-inch through 12-inch shall be Series 5000 MEGA-STOP™ Bell Protection System, as manufactured by EBAA Iron, Inc. Devices shall have an approved coating system for corrosion resistance equivalent to MEGA-BOND® and manufacturing traceability.
- B. Bell restraints for AWWA C900 PVC sizes 4-inch through 12-inch shall be Series 1900 Restraint Harness, as manufactured by EBAA Iron, Inc. Devices shall have an approved coating system for corrosion resistance equivalent to MEGA-BOND® and manufacturing traceability.
- C. Bell restraints for Ductile Iron Pipe sizes 4-inch through 48-inch shall be Series 1700 Restraint Harness, as manufactured by EBAA Iron, Inc. Devices shall have an approved coating system for corrosion resistance equivalent to MEGA-BOND® and manufacturing traceability.
- D. When all-thread attachments are required, **eye-bolt style attachments are not permitted.** Romac “Ductile Lug” style attachments or approved equal shall be used. All-threads shall be made of 316 stainless steel.

2.11 RESTRAINED FLANGED COUPLING ADAPTERS

- A. Flanged coupling adapters used to transition from plain end pipe to a flanged fitting, above ground, shall be EBAA Iron Series 2100 Megaflange or Smith-Blair 911 or 920.
- B. Pressure rating shall be a minimum of 200 psi.

2.12 RESTRAINED COUPLINGS

- A. Restrained couplings to connect two pieces of pipe, size on size, shall be EBAA Iron Series 3800 Restrained Coupling or Smith-Blair 471, 472, or 473.
- B. Pressure rating shall be a minimum of 200 psi.

2.13 BOLTS AND NUTS

- A. All bolts and nuts for valves, fittings, and restraints shall be 316 stainless steel unless otherwise indicated. **Anti-seize lubricant shall be used when assembling all stainless steel hardware to reduce galling.**

2.14 GATE VALVES

- A. Gate valves 2-inch through 12-inch nominal pipe size shall be resilient-seated type, non-rising stem gate valves, in conformance with the requirements of AWWA C509 or AWWA C515, latest revision.
- B. Gate valves shall be Made in USA and shall be Mueller Series 2360, American Flow Control Series 2500, or American AVK Company Series 25 or Series 45.
- C. All gate valves shall be designed for a minimum of 250 psi working pressure. All gate valves shall have 304 stainless steel bolts.
- D. All gate valves shall have O-ring stem seals. The O-ring stem seal shall be so designed that the seal above the stem collar can be replaced with the valve under pressure in the full-open position.
- E. Gate valves shall have standard mechanical joint ends unless otherwise indicated on the Drawings.
- F. Buried gate valves shall be designed for operation with a nominal 2-inch square operating nut. The standard direction of opening shall be open left as viewed from the top.
- G. Handwheels for gate valves shall be in conformance to AWWA C515, latest revision.

- H. The interior and exterior of the valve body and bonnet shall have factory applied fusion bonded epoxy coating meeting AWWA C550, latest revision.
- I. Valves shall be tested in accordance with AWWA C515, latest revision.
- J. Markings shall be cast on the bonnet or body, or stamped on a permanently affixed corrosion-resistant tag of each valve.
 - 1. Manufacturer's name or mark.
 - 2. Year the valve casting was made.
 - 3. Size of the valve.
 - 4. Letters C509 or C515
 - 5. Working water pressure (e.g. 250W)

2.15 BUTTERFLY VALVES

- A. Butterfly valves 14-inch and larger shall conform with the requirements of AWWA C504, latest revision, for Rubber-Seated Butterfly Valves.
- B. Butterfly valves shall be Pratt HP250II or Dezurik BAW.
- C. Butterfly valves shall be designed for a minimum of 250 psi working pressure. Butterfly valves shall have 304 stainless steel bolts.
- D. Butterfly valves shall be of the tight closing, synthetic rubber-seat type, as follows.
 - 1. Valves 20 inches (nominal diameter) and smaller shall have bonded seats which are simultaneously molded in, vulcanized and bonded to the body. Seat bond must withstand 75 pounds pull under test procedure ASTM D429, Method B.
 - 2. On valves 24 inches and larger, all seats shall be of a synthetic rubber compound. Seats shall be retained in the valve body by mechanical means without retaining rings, segments, screws or hardware of any kind in the flow stream. Seats shall be a full 360° without interruption and have a plurality of grooves mating with a spherical disc edge seating surface. Valve seats shall be field adjustable around the full 360° circumference and replaceable without dismantling operator, disc or shaft and without removing the valve from the line.
- E. Valve discs shall utilize an on-center shaft and symmetrical design and be cast from Ductile Iron ASTM A536 Gr. 65-45-12. The disc edge shall be stainless steel type 316.

- F. Butterfly valves shall have standard mechanical joint ends unless otherwise indicated on the Drawings.
- G. Buried butterfly valves shall be designed for operation with a nominal 2-inch square operating nut. The standard direction of opening shall be open left as viewed from the top. The valve shaft shall be constructed of stainless steel and the bearings shall be corrosion resistant and self-lubricating. The valves shall be equipped with a totally enclosed type operator, fully gasketed and grease packed, suitable for direct burial.
- H. The interior and exterior of the valve body and bonnet shall have factory applied epoxy coating system meeting AWWA C550, latest revision.
- I. Valves shall be tested in accordance with AWWA C504, latest revision.
- J. Markings shall be cast on the bonnet or body, or stamped on a permanently affixed corrosion-resistant tag of each valve.
 - 1. Manufacturer's name or mark.
 - 2. Year the valve casting was made.
 - 3. Size of the valve.
 - 4. Class (e.g. 250B)

2.16 BALL VALVES

- A. Ball valves shall be Made in USA, and shall be Ford B11-777-NL or James Jones E1900, with "tee-head" style operating nut.

2.17 VALVE BOXES

- A. Valve boxes shall be Made in USA, and shall be East Jordan Iron Works 8550 Series or Tyler Union 6850 Series, screw type, and shall be of correct length to match the bury of the main.
- B. The valve box and appurtenances shall include a base and a top section with a drop lid. The lid shall be marked with the word "WATER". All lids shall have a concrete pad with a minimum of 18 inches square or round dimension as appropriate.
- C. Lids on valves on fire lines shall be marked with the word "FIRE".
- D. Lids on 2" valves shall be marked with the words "2" VALVE".

- E. Markings shall be cast on each part:
1. Manufacturer's name or mark.
 2. Model number
 3. Year the casting was made.
 4. Material of construction
 5. USA
- F. A valve box alignment device shall be provided and installed for each valve box installation. The device shall be of HDPE or Glass Filled Polypropylene construction. It shall be furnished in two pieces that will lock together under the operating nut of the valve without requiring the removal of the operating nut. The device shall not affect the operation of the valve. The device shall be AFC Alignment Ring as manufactured by American Flow Control.

2.18 OPERATING NUT EXTENSIONS

- A. Operating nut extensions shall be used when the top of the operating nut is greater than 4 feet from the top of finished surface.
- B. The stem shall be 1" SCH40 steel pipe with a 2-inch square bar steel operating nut attached to the upper end. **The stem extension shall be of adequate length to reach from the valve operating nut to a point within 24-inches to 12-inches of the finished surface.** A box wrench, 2 1/8" I.D. square, made from steel 3/16-inches thick shall be welded to the lower end of the stem extension which will fit over the valve operating nut. Two-inch valves with a tee-head operating nut will require a rectangular shaped box wrench on the end of the valve stem extension. The extension shall be secured to the valve operating nut by two 3/8" set screws. A round center guide made from 1/8-inch or 3/16-inch steel plate shall be placed on the valve stem extension approximately 6-inches from the upper end. The diameter of the guide shall be slightly less than the inside diameter of the valve box. The guide shall be affixed to the stem extension in such a way that it can rotate freely on the stem. Welds on stem extensions (top and bottom nut) shall be 1/8" - 3/16" fillet weld around full circumference.
- C. Shop drawings shall be submitted to the City of Fayetteville for approval prior to installing the stem extension pieces.

2.19 FIRE HYDRANTS

- A. Fire hydrants shall be dry barrel hydrants in conformance with AWWA C502, latest revision. Fire hydrants shall be designed for a working pressure of 250 pounds per square inch gauge. Fire hydrants shall be three-way, and painted white with reflective glass beads above the ground line. Coating system shall be compatible with Sherwin Williams SHER-CRYLTM HPA – High Performance Acrylic B66-300 Series that is used to color code the fire hydrants. Permitted fire hydrants are American Flow Control 5-1/4" Waterous Pacer WB67-250 and Mueller Super Centurion 250 hydrants.

- B. Hydrants shall have a 6 inch mechanical joint inlet in conformance to the dimensions shown in ANSI/AWWA C110/A21.10, latest revision. Three-way hydrants shall have a 5-1/4 inch valve opening.
- C. Fire hydrants shall be equipped with a two-piece barrel with a safety stem coupling and a break-a-way flange at the ground line and shall be designed for a 48-inch bury.
- D. Hydrants shall be equipped with two 2-1/2 inch hose nozzles and one 4-1/2 inch pumper nozzle. The operating nut shall be a nominal 1-1/2 inch pentagon, National Standard operating nut designed to open left (counterclockwise).
- E. Hydrants shall be supplied WITHOUT nozzle cap chains.
- F. Fire hydrants in non-paved areas shall be installed with a 24" x 24" square, 12" thick concrete pad, reinforced with 2 layers of #5 rebar, around the lower barrel of the hydrant six inches below the bottom of the break-away flange.
- G. A fire hydrant extension shall be installed in all locations where the centerline of the pumper nozzle is less than 18-inches above the finished grade elevation. The extension shall bring the centerline of the pumper nozzle between 18-inches and 24-inches above the finished grade elevation. The centerline of the pumper nozzle shall be 24-inches above rough grade elevations where sidewalks and yards will be installed in the future, in new subdivisions only. Extensions shall be Waterous K562 or Mueller A-320, with no more than one extension allowed per hydrant.
- H. Identifications tags shall be installed indicating the depth of bury of all hydrants. Additional tags shall be installed indicating the length of any extension installed.

2.20 BLOW-OFFS

- A. Blow-offs shall have a 2-1/2" hose nozzle, traffic break-away, locking cover and be designed for 48-inch bury. Blow-offs shall be Mainguard #77 as manufactured by The Kupferle Foundry Company.

2.21 AIR RELIEF VALVES

- A. All water mains shall have 1"-2" single bodied air and or combination air and vacuum valves or 3"-10" dual bodied combination air and vacuum valve where indicated on the drawings. Valves shall have fiberglass reinforced nylon body or epoxy coated and lined cast iron bodies with stainless steel or non-metallic internal parts. Valve shall have rolling seal mechanism to allow full or partial opening and sealing of orifice or metal to metal stainless steel seating. The 1" – 2" valves float shall be made of foamed polypropylene and shall disrupt vortex and allow float to remain open until a 11 psi differential is achieved. Valves shall have a 250 psi

working pressure. Valves shall be listed under NSF-61 and shall have ISO 9001 certificate. Valves shall be supplied with a male thread outlet or flanged outlet. All nipples and isolation valves for 1"-2" valves shall be brass or stainless steel. Ball style isolation valve shall be full port. Isolation valves for 3"-10" shall conform to Paragraph 2.12 – Gate Valves.

- B. Air release valves shall be A.R.I. Model D-040 for 1" and 2" or A.R.I. Model D-060-C HF NS for 3" – 10", or approved equal.

2.22 SERVICE SADDLES

- A. Service saddles for 1" and 2" NPT service taps shall be sized for use on C900 PVC. Service saddles shall be Romac 101NS.

2.23 TAPPING SLEEVES

- A. Tapping sleeves shall be designed for a minimum 200 psi working pressure and the material being tapped. All bolts and nuts shall be stainless steel.
 - 1. Tapping sleeves for 4-inch through 24-inch shall be stainless steel. Tapping sleeves shall have a **MJ outlet**. Tapping sleeves shall be Smith-Blair 663 or Ford FAST.
 - 2. Tapping sleeves for greater than 24-inches shall be Smith-Blair 622 with Flexi-Coat epoxy. Tapping sleeves shall have a **MJ outlet**.

2.24 SERVICE CONNECTION MATERIALS

- A. Materials and standards for larger meters (3" and greater) are not listed in the standard specifications. Larger meter installations require a site specific design. Please contact the City of Fayetteville Meter Department if you require a meter size 3" or greater.
- B. Brass for meter materials shall be manufactured by Ford Meter Box Company, Inc. or Mueller Company. Equivalent cross referencing for corporation stops and meter setters shall be permitted as approved by the City of Fayetteville. Materials for standard meter sets 5/8", 1", 1-1/2", and 2" are as follows:

Single Meter Set

main diameter x 1" saddle	Romac 101NS
1" corporation stop	Ford FB1000-4-Q-NL
	Mueller B25008N
1" SDR 9 HDPE pipe w/ inserts	
5/8" x 3/4" x 12" meter yolk	Ford VB72-12W-44-43-SQ-NL
	Mueller 238B2567-R--93N
1/2" x 16" SCH 40 PVC brace	
3/4" SDR 9 tail piece w/ insert, 4' long	
18" diameter x 24" deep SDR51 PVC meter box	
18" cast iron flat meter lid	East Jordan 109, w/ Fayetteville logo (35109014)

Double Meter Set

main diameter x 1" saddle	Romac 101NS
1" corporation stop	Ford FB1000-4-Q-NL
	Mueller B25008N
1" SDR 9 HDPE pipe w/ inserts	
1" x 7.5" x 3/4" U branch	Ford U48-43-7.5-Q-NL
	Ford multipurpose end C31-23-NL (x2)
	Mueller H15363N (1" compression inlet)
	Mueller end connection H14222N (x2)
5/8" x 3/4" x 12" meter yolk x 2	Ford VB72-12W-14-33-Q-NL
	Mueller 238B2567-RN
1/2" x 16" SCH"40 PVC brace	
3/4" SDR 9 tail piece w/ insert, 4' long	
18" diameter x 24" deep SDR51 PVC meter box	
18" cast iron flat meter lid	East Jordan 109, w/ Fayetteville logo (35109014)

1-inch Meter Set

main diameter x 1" saddle	Romac 101NS
1" corporation stop	Ford FB1000-4-Q-NL
	Mueller B25008N
1" SDR9 HDPE pipe w/ inserts	
1" x 12" meter yolk	Ford VB74-12W-44-44-Q-NL
	Mueller B24701RN
3/4" x 16" SCH40 PVC brace	
1" SDR 9 tail piece w/ insert, 4' long	
24" diameter x 24" deep SDR51 PVC meter box	
24" cast iron flat meter lid	East Jordan 111, w/ Fayetteville logo (35108004)

1-1/2 inch and 2-inch Meter Set

main diameter x 2" saddle	Romac 101NS
2" brass close nipple	
2" ball valve	Ford B11-777-NL
	James Jones E1900
2" MIP x quick joint	Ford C84-77-Q-NL
	Mueller H15428N
2" SDR 9 HDPE pipe w/ inserts (x2)	
2" MIP x quick joint	Ford C84-77-Q-NL
	Mueller H15428N
2" meter setter	Ford VVB77-15HB-11-77-NL
	Mueller 605H1423--30N
1" x 24" SCH40 PVC brace (x2)	
2" x 24" brass nipple tail piece	
36" diameter x 36" deep composite meter box w/ top ring	East Jordan 8428 Assembly (38003636A01)
28" outer cover, w/ lock	East Jordan 8428E, w/ Fayetteville lettering (00842845A01)
11" inner cover, w/o lock	East Jordan D Meter Cover (32193001)

2.25 TRACER WIRE

- A. Tracer wire shall be 12-gauge solid coated copper or 14-gauge coated copper clad steel for underground burial.
- B. Jacket color shall be BLUE, and made of High Density Polyethylene (HDPE) or High Molecular Weight Polyethylene (HMWPE) designed for direct burial.

- C. Connectors shall be used for all splices or repairs. Connectors shall be moisture displacement style as manufactured by 3M DBR, or equal.
- D. A locate or conductivity test shall be performed prior to signing off on the project.

2.26 MARKING TAPE

- A. Non-metallic water marking tape shall be warning tape as manufactured by Rhino Marking and Protection Systems, Harris Industries, Inc., or approved equal.
- B. Tape shall have a minimum thickness of 4 mils and manufactured with heavy metal-free polyethylene tape that is impervious to all known alkalis, acids, chemical reagents, and solvents found in soil. The minimum overall width of the tape shall not be less than 3-inches. Standard rolls shall be 1000' length.
- C. The tape shall be color coded Safety Blue and imprinted with the following message:
Caution – Buried Water Line Below

2.27 WATER LINE MARKERS

- A. Water line markers shall be TriView Marking System by Rhino Marking and Protection Systems, Carsonite International Dual-Sided Utility Marker (CIB-380), or approved equal. All markers shall be installed according to the manufacturer's recommendations. The uppermost portion of the Carsonite marker shall be made of Visibility Enhancer (CVE-360), or approved equal and must be bolted to the utility marker. TriView markers do not require visibility enhancers. The utility marker shall read as follows: "CAUTION, WATER PIPELINE", "City of Fayetteville", and "Before Digging Call 1-800-482-8998". The label shall also include the official City Logo and be white in color with blue and black lettering. The label shall be affixed to two sides of the marker. **An additional white 1" wide reflective tape (3M or equal) shall be placed around the full circumference of the top of the marker.** Concrete shall be placed 6-inches around and 1-foot deep around the base of each marker.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Water Lines: Refer to Section 4100
- B. Water Service Lines: Refer to Section 4100

END OF SECTION 4000

SECTION 4100

INSTALLATION OF WATER PIPE, FITTINGS, AND MATERIALS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Installation of water lines.
- B. Installation of water service lines.

1.02 RELATED WORK

- A. Section 2300 - Excavation, Backfilling, and Compacting.
- B. Section 4000 - Water Pipe, Fittings, and Materials.
- C. Section 3600 - Cast-In-Place Concrete.
- D. Section 5300 - Inspection and Testing of Water Lines and Service Lines.
- E. Section 6000 - Pavement Repair.
- F. Section 6100 - Lawn and Grass Restoration.

1.03 QUALITY ASSURANCE

- A. Inspect all pipelines per Section 5300 - Inspection and Testing of Water Lines and Service Lines.

1.04 SUBMITTALS

- A. Submit to the Engineer for approval all materials and procedures not described in these specifications.

1.05 PROTECTION

- A. In all cases, the Contractor is responsible for protecting public and private property; protecting any person or persons who might be injured as a result of the Contractors' Work.
- B. All utilities shown on the plans may not represent the exact location; however, the Contractor is responsible for verifying these locations and contacting "Arkansas One Call System" before excavating.

PART 2 - PRODUCTS

2.01 BEDDING AND BACKFILL

- A. Refer to Section 2300 - Excavation, Backfilling, and Compacting.

2.02 PIPE, FITTINGS, AND MATERIALS

- A. Refer to Section 4000 – Water Pipe, Fittings, and Materials.

2.03 CONCRETE

- A. Refer to Section 3600 - Cast-In-Place Concrete.

PART 3 - EXECUTION

3.01 EXCAVATION - GENERAL

- A. Perform excavation and prepare bedding in accordance with Section 2300 - Excavation, Backfilling, and Compacting.
- B. Never lay pipe in a water-filled trench, or when trench conditions or weather are unsuitable for such Work.
- C. Divert surface water and de-water trenches during excavation.
- D. Excavate for bells so that the entire barrel of the pipe will be uniformly supported on the pipe bedding before placing pipe in the trench.

3.02 LAYOUT

- A. The Contractor shall install water lines, valves, fire hydrants, water meters, and other work as shown on the Drawings.

3.03 PIERS

- A. Install concrete piers as indicated on the plans per Section 3600 - Cast-In-Place Concrete.

3.04 COLD WEATHER INSTALLATION

- A. The City reserves the right to order pipe installation discontinued whenever, in its opinion, there is danger of the quality of work being impaired because of cold weather. The Contractor shall be responsible for heating the pipe and jointing material so as to prevent freezing of joints. Do not lay any pipe on frozen ground. **No flexible or semi-rigid pipe shall be laid when the air temperature is less**

than 32° F unless proper precautions per the manufacturer's recommendations are taken by the Contractor and the method is approved by the Engineer and City.

- B. When pipes with rubber gaskets or resilient-type joints are to be laid in cold weather, sufficiently warm the gasket or joint material so as to facilitate making a proper joint.

3.05 PIPE INSTALLATION – PUSH-ON JOINTS

- A. Inspect each joint of pipe carefully internally and externally before it is placed in the trench. Plainly mark and separate from the remaining pipe any joint found to be cracked, warped, or otherwise damaged. Remove these damaged joints from the project site as soon as possible.
- B. Cut pipe in a neat and workmanlike manner without damage to pipe or pipe lining when trimming joint length. Cut ends shall be beveled according to the manufacturer's recommendation to prevent damage to the bell gasket.
- C. **Devices for the prevention of “over-insertion” shall be assembled onto the spigot end of PVC pipe at the stop line per manufacturer's installation instructions before lowering the pipe into the trench.**
- D. Use proper equipment for lowering sections of pipe into trenches. Lower pipe carefully into the trench so the spigot and bell will not become contaminated.
- E. Lay each pipe joint to line and grade as shown on the drawings. Keep a minimum of six inches between the pipe and the trench wall.
- F. Keep the pipe joints' interior clean from all dirt and other foreign matter as the Work progresses. Maintain the pipe's interior cleanliness until accepted or put in service.
- G. Close the open ends of the pipeline temporarily with an appropriate manufactured watertight plug at the end of each day's Work or when discontinuing pipe installation for an appreciable period.
- H. TRACER WIRE
 - 1. Tracer wire shall be installed on all buried water lines and service lines.
 - 2. Tracer wire shall be installed 6-inches above the top of the pipe.
- I. MARKING TAPE
 - 1. Marking tape shall be installed on all buried water lines and service lines.
 - 2. Marking tape shall be installed 18-inches above the top of pipe.

3.06 PIPE INSTALLATION – MECHANICAL JOINT CONNECTIONS

- A. The spigot end of the pipe, the bell of the connecting pipe, and the rubber gasket shall be thoroughly cleaned using soapy water and cloth, removing all foreign materials from the bells, especially the gasket seats as specified for push-on joints. Clean the gland in a similar manner. An approved pipe lubricant shall be applied to the spigot end of the pipe and the gasket.
- B. After the gland and gasket are placed on the spigot end of the pipe, a sufficient distance from the end to avoid fouling the bell, insert the spigot end in the fitting bell to the point of firm contact with the bell shoulder. Then advance the rubber gasket into the bell and seat in the gasket seat. **Hammering the gasket into the seat is not permitted.** Exercise care to center the spigot end within the bell. Bring the gland into contact with the gasket, enter all bolts, and make all nuts hand tight. Exercise continued care to keep the spigot centered in the bell.
- C. Make the joints tight by turning the nuts with a torque wrench: First partially tighten a nut, then partially tighten the nut 180 degrees away from it. Work around the pipe with uniformly applied tension until the required torque is applied to all nuts.
- D. The Contractor shall provide a torque wrench suitable for measuring tension on bolts for at least such a time as the workmen making the joints have gotten the "feel" of the required tension. At no time should handles longer than those supplied by the wrench manufacturer be permitted. The torque range shall be as follows:

Diameter <u>Inches</u>	Range of Torque <u>Foot Pounds</u>
5/8	45 – 60
3/4	75 – 90
1	85 – 100
1-1/4	105 – 120

- E. Proper actuation of the gripping wedges for restraining glands shall be ensured with torque limiting twist off nuts. Tightening sequence shall be as follows. First partially tighten a nut, then partially tighten the nut 180 degrees away from it. Work around the pipe with uniformly applied tension until the required torque is applied to all nuts. **Failure to follow proper the proper tightening sequence will result in the disassembly of the joint, removal of the current restraining gland, and installation of a new restraining gland. Any damage to PVC pipe shall be removed as well.**
- F. All buried iron pipes, valves, and fittings shall be double poly wrapped.

3.07 SOLID SLEEVE INSTALLATION

- A. Solid sleeves shall be installed the same as mechanical joint connections for pipe installation.
- B. The maximum gap between the two pipes being connected by a solid sleeve shall be one-half (1/2) inch.

3.08 VALVE INSTALLATION

- A. Valves shall be jointed in accordance with the methods of jointing pipe as specified elsewhere herein. Valve stems shall be plumb and there shall not be any obstructions that will prohibit the installation of valve boxes directly over the stem. Mechanical joint retainer glands shall be installed on all valves with mechanical joint ends.
- B. All valves shall be firmly supported from below with compacted crushed stone up to and including 12-inch valves, or concrete for all valves 14-inches and greater.
- C. All valves shall be double poly wrapped
- D. Valve boxes shall be installed over the operating nut of each valve and be of adequate length to reach the finished ground or paved surface. Valve boxes shall be installed with a HDPE Valve Box Alignment Device of the proper size and manufacture to fit the valve and the valve box. Boxes shall be firmly supported, plumb, and centered over the valve operating nut. No part of the box shall rest on the valve. The box cover shall be flush with the finished surface.
- E. Operating nut extensions shall be used when the top of the operating nut is greater than 4 feet from the top of finished surface. **The stem extension shall be of adequate length to reach from the valve operating nut to a point within 24-inches to 12-inches of the finished surface.**
- F. Tracer wire shall be brought up on the OUTSIDE of the valve box. A hole or notch shall be made through the valves box approximately 4-inches below the top. The tracer wire shall be pushed through the hole or notch. Approximately 12-inches of wire shall be coiled inside the valves box for traceability. The tracer wire shall not interfere with the insertion of the lid onto the valve box.
- G. All lids shall have a concrete pad with a minimum dimension of 18 inches square or round as appropriate. A concrete pad with a minimum dimension of 36 inches square or round as appropriate shall be installed for all valves 24-inches and larger.

3.09 FIRE HYDRANT INSTALLATION

- A. **Pipe used to install fire hydrants from the main line to the base of the fire hydrant shall be 6-inch ductile iron pipe. All pipe from the valve on the water main to the fire hydrant shall be fully restrained.**
- B. A separate maintenance valve, in addition to the valve anchored to the main, shall be installed on all fire hydrant leads exceeding 30 feet.
- C. Hydrants shall be thoroughly cleaned before setting, removing all dirt and foreign matter from the barrel and bottom section up to the main valve. The main valve shall be in the "closed" position and the waste outlet shall be free of any obstructions.
- D. **The Contractor shall take great care to protect the factory applied coating system.** Means and methods for the protection of the fire hydrant are the responsibility of the Contractor. At no time shall chains or other abrasive materials come into contact with the factory applied coating system.
- E. Minor touchup for “incidental” scratches is permitted using factory provided touchup kits.
- F. **When the factory applied coating system (from the bury line up), as identified by the City of Fayetteville, has damage other than “minor scratches,” a new upper barrel section shall be ordered and delivered from the factory, inclusive of all internal working parts up to the operating stem breakaway. The upper barrel shall be replaced, and the damaged upper barrel returned to the factory at no cost to the City of Fayetteville.** This includes, but is not limited to, excessive scratches, appearance of rust, or other aesthetic flaws. Field repainting of new fire hydrant installations is not permitted.
- G. Hydrants shall be located a safe distance from driveways, roadways and narrow type sidewalks and in a manner to provide complete accessibility, and they shall stand plumb with nozzles at proper elevation. The hydrant’s “bury line” shall be set at or no more than four (4) inches above the finished grade elevation; therefore the bottom of hydrant nozzles shall be 18 to 22 inches above the finished grade elevation.
- H. Installation of fire hydrant extensions shall be made in the presence of the Engineer or the Engineer’s representative and shall be per the manufacturer’s instructions. **The breakable flange and breakable stem coupling shall be removed and installed above ground level.**
- I. The Contractor shall, if necessary, rotate the hydrant barrel or nozzle section at the flanged joint to obtain the desired nozzle position as specified by the Engineer. The pumper nozzle shall be at a right angle to and face the street unless otherwise directed by the Engineer.

- J. The bowl or bottom of the hydrant shall be supported firmly on the bottom and shall be braced against unexcavated earth at the end of the trench with concrete reaction backing. Solid concrete blocks may be used to support the bottom of the hydrant. If considered necessary by the Engineer, the hydrant shall be tied to the branch pipe with suitable Series 300 STAINLESS STEEL rods or clamps. These rods or clamps shall be furnished by the Contractor without additional compensation.
- K. A drainage bed shall be provided under and around the base of the hydrant of at least six (6) cubic feet in volume and extending at least six inches (6") above the drain outlet and shall consist of ASTM #67 gravel. Under no circumstances shall the drain outlet on the hydrant or the drainage bed be connected to a sewer.
- L. Backfilling and tamping around hydrant barrels shall be continuous in operation.
- M. If a fire hydrant is not located inside a concrete paved area, then a 2.0' x 2.0' x 1.0' (deep) Class "A" concrete pad, reinforced with two layers of #5 reinforcement steel, shall be poured just below the break-away joint of the fire hydrant barrel.
- N. Fire hydrants, immediately after installation, shall be covered and wrapped with a heavy cloth, water-resistant sack, or black polyethylene sheeting, well taped in place around the hydrant, to identify the hydrant as being "not in service".
- O. All fire hydrants installed within the City of Fayetteville water operational territory shall be painted white with glass reflective beads above the ground line. Factory coating system shall be compatible with Sherwin Williams SHER-CRYL™ HPA – High Performance Acrylic B66-300 Series that is used to color code the fire hydrants. Sherwin Williams DTM ACRYLIC COATING shall be used for the Safety Orange color only, as it is not available in HPA.
- P. All fire hydrant nozzle caps, and operating nuts shall be painted with two coats of paint according to the following table:
- | <u>Flow Under Fire Conditions</u> | <u>Color</u> | <u>Color Specification</u> |
|-----------------------------------|--------------|----------------------------|
| More than 1500 gpm | Light Blue | Robotic Blue SW4063 |
| 1000 to 1499 gpm | Green | Safety Green SW4085 |
| 500 to 999 gpm | Orange | Safety Orange SW4083 |
| Less than 500 gpm | Red | Safety Red SW4081 |
- Q. The City of Fayetteville shall provide the flow under fire conditions for each new fire hydrant installation based upon the current water modeling software or based upon a current fire hydrant fire flow test performed in the area.

3.10 METER SETTINGS

- A. Meter settings shall be installed where shown on the Drawings and/or as directed by the City. Installation shall be as per the Standard Details. Meter setters shall be installed in a horizontal and plumb position within the meter box and at a depth to provide the required space between the top of the meter and the bottom of the meter box lid.
- B. A drainage bed consisting of ASTM #67 stone shall be placed a minimum of 6-inches thick and 6-inches outside the edge of the bottom of the meter box. Non-woven filter fabric consisting of 8 oz/sy shall be placed on top of the drainage bed. The filter fabric shall extend 12-inch outside the edge of the bottom of the meter box. After the installation of the water service line, meter setter, meter box, and lid, the filter fabric shall be wrapped up the meter box and service line penetrations and taped securely to the meter box to provide a "dirt seal" before backfilling.
- C. Tracer wire shall be brought up on the INSIDE of the meter box with the water service line. Sufficient tracer wire shall be provide such that approximately 12-inches of wire will extend beyond the top of the box when pulled taunt. The tracer wire shall be loosely coiled and place inside the meter box. **Do not wrap the tracer wire around the meter setter.**
- D. The bottom of the meter setter connections shall be visible at the bottom of the meter box at the time of testing and of final inspection. Any dirt or debris in the bottom of the meter box shall be removed before the project is released for final payment and/or acceptance.
- E. The final grade at the meter box location shall be determined by the Engineer of Record and the meter box shall be placed at that grade. Final grade should take into account probable future installation of topsoil and/or sod. Any boxes falling in driveways or sidewalks shall be relocated at the expense of the developer or lot owner. No meters shall be set by the City until the meter box is adjusted to the proper grade.

3.11 BLOW-OFF INSTALLATION

- A. Blow-off hydrants shall be thoroughly cleaned before setting, removing all dirt and foreign matter from the barrel and bottom section up to the main valve. The main valve shall be in the "closed" position and the waste outlet shall be free of any obstructions.
- B. Blow-off hydrants shall be installed in such a manner to provide complete accessibility, and they shall stand plumb with nozzles at proper elevation. The discharge nozzle shall be a minimum of 24-inches above finished grade elevation.

- C. The bowl or bottom of the blow-off hydrant shall be supported firmly on the bottom and shall be well braced against unexcavated earth on the backside of the blow-off hydrant. Solid concrete blocks, or other suitable material may be used to block the blow-off hydrant.
- D. A drainage bed shall be provided under and around the base of the blow-off hydrant of at least six (6) cubic feet in volume and extending at least six inches (6") above the drain outlet and shall consist of ASTM #67 gravel. Under no circumstances shall the drain outlet on the hydrant or the drainage bed be connected to a sewer.
- E. Backfilling and tamping around blow-off hydrant barrels shall be continuous in operation.
- F. Blow-off hydrants, immediately after installation, shall be covered and wrapped with a heavy cloth, water-resistant sack, or black polyethylene sheeting, well taped in place around the hydrant, to identify the hydrant as being "not in service".

3.12 TAPPING SADDLE INSTALLATION

- A. Tapping saddles shall be used for 1-inch and 2-inch service taps.
- B. The pipe shall be free of dirt and other debris before attaching tapping saddle. That part of the pipe barrel, other than concrete pipe, which will be in contact with the gasket of tapping saddles, shall be smooth. All rough areas on the pipe barrel shall be smoothed. The Contractor shall field verify all pipe and fitting dimensions. Tapping saddles shall be installed at least twenty-four (24) inches from bell joints, fittings, end of pipe joint, or another tap.
- C. Tapping saddles shall be bolted securely to the pipe. The face of the outlet shall be zero to ten (0-10) degrees from horizontal. The bolts for tapping saddles shall be alternately tightened "snug" and then alternately tightened to a torque as recommended by the manufacturer.
- D. The tapping valve shall be attached securely to the tapping saddle to provide a water tight seal. **Proper tools for installing brass hardware shall be used.**
- E. The pilot drill and shell cutter shall be in good condition. The pilot, shell cutter, and any other component of the tapping machine that will or may come into contact with the interior of the tap valve or potable water pipe, shall be thoroughly sterilized with straight bleach or super-chlorinated solution. The shell cutter shall be the size required to cut the full opening specified.
- F. **After the tap is complete and the tapping machine has been removed, the bolts for the tapping saddle must be re-torqued per the manufacturer's specifications to ensure a proper seal.**

- G. The tapping saddle shall be enclosed in polyethylene material in accordance with Paragraph 3.14 of these specifications.

3.13 TAPPING SLEEVE INSTALLATION

- A. The pipe shall be free of dirt and other debris before attaching tapping sleeve. That part of the pipe barrel that will be in contact with the gasket of tapping sleeve, shall be smooth. All rough areas on the pipe barrel shall be smoothed. The Contractor shall field verify all pipe and fitting dimensions. Tapping sleeves shall be installed at least twenty-four (24) inches from bell joints, fittings, end of pipe joint, or another tap.
- B. Tapping sleeves shall be bolted securely to the pipe. The face of the outlet shall be plumb. Mechanical joint glands for tapping sleeves shall be installed in accordance with Paragraph 3.06 herein. The bolts for tapping sleeves shall be alternately tightened "snug" and then alternately tightened to a torque as recommended by the manufacturer.
- C. The tapping valve shall be bolted securely to the tapping sleeve. The tapping valve shall be adequately supported from beneath. The weight of the tapping valve shall not be supported by the tapping sleeve. A concrete "mud slab" at least six (6) inches thick shall be poured under the location of all tapping valves 14 inches and larger and the weight of the valve shall be supported by the mud slab. The tapping machine shall be bolted securely to the valve.
- D. After installation of the tapping sleeve and the tapping valve and before drilling through the pipe, the assembly shall be hydrostatically tested at the pressure specified in Section 5300, herein, by introducing water through the sleeve test tap.
- E. The pilot drill and shell cutter shall be in good condition. The pilot, shell cutter, and any other component of the tapping machine that will or may come into contact with the interior of the tap valve or potable water pipe, shall be thoroughly sterilized with straight bleach or super-chlorinated solution. The shell cutter shall be the size required to cut the full opening specified.
- F. Openings in the pipe barrel for tapping saddles installed on dry pipe shall be cut with a pilot drill and shell cutter. Torch cutting is not permitted.
- G. Tapping operations must not commence before inspection by the Engineer or his authorized representative. Tapping operations must not commence before the tapping assembly has passed a pressure test as detailed in Section 5300 herein.
- H. Only qualified operators shall operate the tapping machine. The "coupon" shall be withdrawn and be given to the Engineer for inspection. Care shall be exercised to avoid drilling or cutting the backside of the pipe by carefully assuring the engagement of the pilot drill and shell cutter shaft.

- I. **After the tap is complete and the tapping machine has been removed, the bolts for the tapping sleeve must be re-torqued per the manufacturer's specifications to ensure a proper seal.**
- J. All taps 14-inch and larger shall require the installation of a butterfly valve immediately after the tapping valve. The tapping valve shall be fully opened and abandoned in place.
- K. The tapping sleeve shall be enclosed in polyethylene material in accordance with Paragraph 3.14 of these specifications.
- L. Tapping sleeves shall be adequately thrust blocked with concrete.

3.14 INSTALLATION OF POLYETHYLENE PROTECTION MATERIAL

- A. Polyethylene material, either in tubing form or in the form of flat sheet or rolls, as specified herein, shall be placed around all buried mechanical joints of pipe and fittings, valves, fire hydrants, and all saddles, sleeves, and couplings, tapping saddles, and any other appurtenance with exposed bolts. Any and all iron or steel components installed below ground shall be wrapped with the polyethylene material.
- B. Ductile iron and steel pipe and appurtenances shall be completely encased in polyethylene tubing material. It is not the intent that the material form an enclosure that is absolutely air or water tight, but to prevent pipe to soil contact.
- C. Polyethylene tubing shall be applied to pipe in double layers by one of the following methods:
 - 1. Method "A": Cut polyethylene tubes to a length approximately two feet (4') longer than the length of the pipe section. Slip the tubes around the pipe, centering it to provide a one foot (2') overlap on each adjacent pipe section, and bunching it accordion fashion lengthwise until it clears the pipe ends. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at joints to facilitate installation of the polyethylene tube. After assembling the pipe joint, take bunched polyethylene from the preceding length of pipe, slip it over the end of the new length of pipe, and secure in place. Then slip the end of the polyethylene from the new pipe section of the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Secure the overlap in place. Take up the slack width to make snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points with tape.
 - 2. Method "B": Cut polyethylene tubes to a length approximately one foot (1') shorter than the length of the pipe section. Slip the tubes around the pipe, centering it to provide six inches (6") of bare pipe at each end. Make

polyethylene snug, but not tight; secure ends. Before making up a joint, slip two sections of six foot (6') length of polyethylene tube over the end of the preceding pipe section, bunching it accordion fashion lengthwise. After completing the joint, pull the two sections of six foot (6') length of polyethylene over the joint, overlapping the polyethylene previously installed on each adjacent section of pipe by at least two feet (2'); make snug and secure each end.

- D. Pipe-Shaped Appurtenances. Bends, reducers, offsets, and other pipe-shaped appurtenances shall be covered with double layers of polyethylene in the same manner as the pipe.
- E. Odd-Shaped Appurtenances. Valves, tees, crosses and other odd-shaped pieces which cannot practically be wrapped in a tube, shall be wrapped with two layers of flat sheets or split length of polyethylene tubes. The sheets shall be passed under the appurtenance and brought up around the body. Seams shall be made by bringing the edges together, folding over twice, and taping down. Slack width and overlaps at joints shall be handled as described in Paragraph 3.13.C.1 above. Tape polyethylene securely in place at valve stem and other penetrations.
- F. Openings in Tubing Material. Openings for branches, service taps, blow-offs, air valves, and similar appurtenances shall be made by making an "X" shaped cut in the polyethylene and temporarily folding the film back. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut, as well as any other damaged areas in the polyethylene with tape.
- G. Junctions Between Wrapped and Unwrapped Pipe. Where polyethylene wrapped pipe joins a pipe that is not wrapped, extend the polyethylene tube to cover the unwrapped pipe a distance of at least two feet (2') and secure the end.
- H. The polyethylene material shall be secured around the pipe and appurtenances by at least three (3) circumferential wraps of tape (see Section 4000 for materials).
- I. All tongs, cables, or chains that are used for lifting pipe and appurtenances that have been encased in polyethylene material shall be adequately padded to prevent damage to the material.
- J. Repair any rips, punctures, or other damage to the polyethylene with tape or with a short length of polyethylene tube cut open, wrapped around the pipe and secured in place.
- K. Polyethylene material shall be stored on the job site in such a manner that it is not exposed to direct sunlight. Exposure during installation shall not exceed forty-eight (48) hours.

- L. Backfill material shall be the same as specified for pipe without polyethylene wrapping. Special care shall be taken to prevent damage to the polyethylene wrapping when placing backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, and/or other material that could damage polyethylene.

3.15 CONCRETE THRUST BLOCKS AND ANCHOR COLLARS

- A. Concrete thrust blocks and anchor collars shall be provided along the water line in accordance with the construction details, plan sheets, or as directed by the Engineer. The concrete mix (as defined in Section 3600 herein) shall be Class "B" for anchor collars and Class "A" for thrust blocks. All bends, tees, caps, plugs, and fire hydrants shall be thrust blocked unless specifically detailed in the construction drawings that no thrust blocking is required. **Anchor collars shall be constructed on ductile iron pipe only;** if the pipeline being restrained is primarily PVC or other non ductile iron pipe, at least one full joint of ductile iron pipe shall be inserted in the pipeline run to receive the concrete anchor collar.
- B. Concrete for thrust blocks and anchor collars shall be placed against undisturbed soil. The excavation shall be hand shaped and free of loose material. Forms shall be used to confine the concrete in areas other than that part that is in contact with undisturbed soil in the direction of the thrust.
- C. No concrete shall be placed around any part of a joint or placed so that it interferes with the removal of any joint accessories such as bolts, followers, threads, collars, couplings, etc. Fire hydrant drains shall not be restricted.
- D. The top of the concrete thrust block or anchor collar shall be struck off with a wood straight edge or float.
- E. Concrete shall not be placed when the temperature is below 40° F and dropping or below 35° F if the temperature is rising, unless approved by the Engineer.
- F. Admixtures are not to be used without the approval of the Engineer.
- G. All reinforcement shall be inspected by the Engineer prior to placement of concrete. All placement of concrete must be in the presence of the Engineer or his representative. The Contractor is cautioned that he may be required to remove, without compensation, any concrete placed in the absence of the Engineer or his representative.
- H. Backfill over concrete thrust blocks or anchor collars shall not be placed before the concrete has attained initial set.
- I. No thrust blocks shall be less than six inches (6") thick between the pipeline or appurtenances and undisturbed soil in the direction of thrust on pipes 12-inch diameter and smaller. On larger pipes, the thickness of thrust blocks shall be as

directed by the Engineer. A thrust block with any component of its length to width to depth ratio exceeding two (2) shall be reinforced with steel reinforcement bars as directed by the Engineer. The Engineer will consider the size of the thrust block, the size of the water main, and the system pressure in the determination of the size and spacing of the steel reinforcement.

- J. The excavation shall be free of water before concrete is placed. Steel reinforcement shall be placed as specified on the drawings.
- K. The pipe or appurtenances to be in direct contact with concrete shall be cleaned before placing the concrete.
- L. The area of contact of the thrust blocks and anchor collars shall be sufficient to resist the thrust. This will vary depending on the safe bearing value of the soil. Suggested safe soil bearing values are as follows:

TYPE OF SOIL SUGGESTED SAFE BEARING VALUES (TONS \ SQ. FT.)	
Solid Rock	25.00
Hard Shale	6.00
Medium Shale	4.00
Soft Shale	2.00
Dry Clay or Gravel	4.00
Dry Sand or Loam	3.00
Wet Sand	2.00
Firm Clay	2.00
Soft Clay	1.50
Wet Clay	1.00

The above values are approximate, will vary considerably, and are intended to be used only as a guide. The Contractor is responsible for determining the soil bearing value or taking other action to assure that the bearing area is adequate to restrain the pipe or appurtenances.

- M. Where the soil is unstable or in the case of recent fill areas, the following procedures shall apply either singly or in a combination:
 - 1. Thrust blocks shall be of adequate size to restrain pipe or appurtenances by mass alone without depending on horizontal bearing of the soil.
 - 2. The excavation shall extend deep enough to contact firm soil and the thrust block concrete brought up to the pipe or appurtenances. The thrust block shall be constructed so that the block acts as a beam and will

provide the restraint required. Such block shall be reinforced with steel reinforcing bars.

3. Anchor blocks shall be constructed in a firm soil and tie rods extended to the pipe or appurtenances. Tie-rods shall be used only for temporary restraint. Concrete thrust blocks and/or anchor collars must be placed for permanent restraint.
- N. Thrust blocks for vertical bends shall be adequate to resist the thrust by mass alone when the thrust is upward.
- O. Thrust blocks and anchor collars shall be adequate to restrain the pipeline and appurtenances at design pressure equal to 150% of the static pressure at the lowest point with a minimum pressure of 200 psi. The following table lists the resultant thrust at certain fittings at a pressure of 100 psi. In order to determine the thrust at the test pressure, these values are to be multiplied by a factor equal to the design pressure divided by 100.

Thrust per 100 psi Pressure											
Thrust (tons)											
Fitting	6"	8"	12"	16"	18"	20"	24"	30"	36"	42"	48"
11 1/4	0.4	0.6	1.3	2.3	2.9	3.6	5.1	7.9	11.3	15.2	19.9
15	0.5	0.8	1.8	3.1	3.9	4.8	6.8	10.5	15.0	20.3	26.5
22 1/2	0.7	1.3	2.7	4.6	5.8	7.1	10.2	15.7	22.5	30.3	39.5
30	1.0	1.7	3.5	6.2	7.7	9.5	13.5	20.8	29.8	40.3	52.5
45	1.4	2.5	5.2	9.1	11.4	14.0	20.0	30.8	44.1	59.5	77.6
90	2.6	4.5	9.7	16.8	21.1	25.9	37.0	56.9	81.5	110.0	143.3
Plug/Tee/ Dead End	1.9	3.2	6.8	11.9	14.9	18.3	26.1	40.2	57.6	77.8	101.3

- P. Concrete thrust blocks and anchor collars on **12-inch and smaller pipelines** shall have a minimum curing time of **three days** (72 hours) before any pressure is placed against the block or collar. Concrete thrust blocks and anchor collars on **14-inch and larger pipelines** shall have a minimum curing time of **seven days** before any pressure is placed against the block or collar.
- Q. Concrete thrust blocks or anchor collars that fail to restrain the pipe or appurtenances shall be replaced by the Contractor at his expense.
- R. Reducers receiving an anchor collar shall be long bodied fittings.
- S. All water lines with dead ends shall be installed with an upstream valve, one full joint of ductile iron pipe with a MJ restraining gland, concrete anchor collar, a MJ cap with restraint, and a blow off assembly. The seat of the MJ restraining gland on the ductile iron pipe shall face the valve.

- T. Anchor collars subject to two-way thrust shall have two identical “A”/”B” reinforcement steel mats as shown in the Detailed Drawings. Anchor collars for 24” and smaller diameter pipe with two-way thrust shall have two (2) Mega-Lug retaining glands placed back-to-back, spaced just inside the two reinforcing steel mats. Anchor collars for 26” and larger diameter pipe shall have two weld-on thrust rings, spaced just inside the two reinforcing steel mats.

3.16 BACKFILLING AND INSPECTION

- A. Before backfilling, install concrete thrust blocks and anchor collars in accordance with the details at the location and interval and shown on the Drawings. Use concrete as specified in Section 3600-Cast-In-Place Concrete.
- B. After the pipeline is installed and visually inspected by the Engineer, backfill the trench per Section 2300-Excavation, Backfilling, and Compacting.
- C. Test the pipeline per Section 5300-Inspection and Testing of Water Lines and Service Lines.
- D. Repair all pavements per Section 6000-Pavement Repair.
- E. Repair all incidental damage to buildings, structures, utilities, pavements, landscaping, etc.
- F. Repair sodded and grass areas to original condition per Section 6100-Lawn and Grass Restoration.

3.17 WATER LINE INSTALLATION - AERIAL CROSSINGS

- A. Construct piers as shown on Drawings.
- B. Install encasement pipe on piers as shown on the Drawings.
- C. Insulate encasement as required by the City.

3.18 SEWER LINE CROSSINGS

- A. Sewer lines installed under a water line must have a clear distance between pipes of at least eighteen (18) inches.
- B. The sewer line shall be installed such that a joint of pipe is centered along the water line and the joints are as far as possible from the water line.
- C. If 18-inches of clearance cannot be provided or when the water main must pass under the sewer main, either the sanitary sewer main or the water main shall be encased in watertight steel encasement pipe a minimum of 10 feet either side of

the line, centered over the point of crossing. The ends of the encasement pipe shall be sealed watertight. Refer to Section 3400 – Steel Encasement Pipe for end seals.

3.19 STORM SEWER CROSSINGS

- A. All water lines crossing under all concrete storm drains, or any storm drain 30-inch diameter and larger, or all storm drains with multiple pipe runs, shall be steel encased a minimum of 5 feet either side of the storm drain.

3.20 CUT AND CAP

- A. Water lines that are to be abandoned shall be cut and capped as shown on the detail drawings.
- B. Mechanical joint restraints and concrete shall be used to resist thrust loads.

3.21 ABANDON CORPORATION STOP

- A. All corporation stops used for testing and/or chlorination need to be properly abandoned by fully closing the corporation stop, removing all service line materials, installing a solid copper disk, and reinstalling the corporation nut resulting in a water tight seal in the event that the corporation valve fails.

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END OF SECTION 4100

SECTION 4200

WATER LINE PRESSURE REDUCTION PROCEDURES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the procedures associated with reducing water line pressure for construction.

1.02 PROCEDURES

- A. Water lines may need to have the pressure significantly reduced to facilitate construction in a project area, i.e tie-ins or cut and caps.
- B. Water pressure reductions shall be approved and coordinated with the City of Fayetteville Water & Sewer Department.
- C. The maximum amount of time that the line is permitted to be shut down shall be determined by the City of Fayetteville Water & Sewer Department.
- D. The Contractor shall have sufficient materials, labor, and necessary backup provisions in place prior to initiating water line pressure reduction to ensure that construction activities can be completed within the time determined by the City of Fayetteville Water & Sewer Department.
- E. A minimum of 72-hour notice shall be provided to each affected customer using the attached water pressure reduction notice.
- F. The Contractor shall distribute the notices and generate a list of each address that the notices are delivered to. The list shall be given to the City of Fayetteville Water & Sewer Department for their files.

1.02 CONSTRUCTION REQUIREMENTS

- A. The excavation in the project area shall be dewatered prior to pressure in the water main being reduced.
- B. All water pipe, fittings, and materials shall be disinfected per AWWA C651, latest revision.
- C. Immediately after construction is complete, the existing water lines shall be flushed thoroughly and background chlorine levels re-established.

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www.accessfayetteville.org

THE CITY OF FAYETTEVILLE, ARKANSAS

WATER AND SEWER DIVISION

113 West Mountain

Fayetteville, AR 72701

P (479) 575-8386 F (479) 684-4730

WATER SYSTEM NOTICE TO THE CUSTOMER
WATER PRESSURE REDUCTION

DATE: _____

Due to scheduled water system maintenance in your area, the contractor listed below, under supervision of the engineer listed below, must significantly reduce the water pressure in the area serving your business or residence. The water pressure will be reduced at the following time:

DATE TURNED DOWN: _____

TIME TURNED DOWN (approximate): _____

TIME TURNED BACK ON (approximate): _____

The pressure will probably be reduced such that you will not have water available in your residence or business. We are attempting to make the repairs in this way to avoid having to put your home or business on a precautionary boil order. Your water will be perfectly safe to drink as soon as full pressure is restored.

If the repair does not work as we expect and a boil order becomes necessary, you will be notified, in writing, when the need for the boil order is identified.

If you need to draw water for use, please do so before the time we will be reducing pressure.

If you have any questions, please call one of the following:

Engineer: _____
Company and Contact Name Phone

Contractor: _____
Company and Contact Name Phone

Thank you for your patience and consideration.

Water & Sewer Maintenance
479-575-8386

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END OF SECTION 4200

SECTION 5000

SEWER LINE CLEANING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This Section covers the cleaning of sewer lines.

1.02 RELATED WORK

- A. Standard Detail Drawings
- B. Section 3100 – Installation of Sewer Pipe, Fittings, and Materials
- C. Section 3200 – Installation of Sewer Service Lines
- D. Section 3300 – Manholes
- E. Section 5100 – Sewer Line Television Inspection

1.03 SUBMITTALS

- A. The Contractor shall submit for approval manufacturer's brochures and specifications for his proposed cleaning equipment. The equipment and methods selected for cleaning shall be approved by the Engineer.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Equipment selected for cleaning shall be of a type generally recognized by the trade for the purpose being used and that has proved satisfactory. The equipment shall be capable of removing all roots, dirt, grease, rock and other deleterious material and obstructions from the sewer lines and manholes that would prevent efficient use of the inspection equipment.
1. Hydraulic cleaning equipment shall be of a movable dam type and shall be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. Sewer cleaning balls or other such equipment which cannot be collapsed instantly will not be considered acceptable cleaning equipment. The moveable dam shall be of the same diameter as the pipe being cleaned and shall provide a flexible scraper around the outer periphery to insure total removal of grease. If a line segment is found to be completely stopped up or plugged or heavily intruded with roots, then a mechanical root cutter shall be used.
 2. High velocity hydro-cleaning equipment shall be truck mounted for ease of operation. The equipment shall have minimum of 600 feet of 1 inch I.D. high pressure hose with a selection of two or more high velocity nozzles. The nozzles shall have a capacity of 60 GPM at a minimum working pressure of 1000 pounds per square inch (psi). The nozzles shall be capable of producing a scouring action from 15 degrees to 45 degrees in all size lines designated to be cleaned. Equipment shall also have a high velocity gun for washing and scouring manhole walls and floor. The equipment shall carry its own water tank capable of holding corrosive or caustic cleaning or sanitizing chemicals, auxiliary engines, pump and a hydraulically driven hose reel. All controls shall be located so that equipment can be operated above ground with minimal interference to traffic and/or danger to the operator.
 3. Mechanical cleaning equipment shall be used to remove heavy accumulations of silt, sludge, etc., and roots. Bucket machines shall be operated in pairs with each machine powered by an engine with a minimum of 16 horsepower (HP) to ensure sufficient pulling power. Machines shall be capable of operating at least two speeds to match job conditions. Sufficient accessories and tools shall be furnished to accomplish the required cleaning in a complete and efficient manner.
 4. Power rodding machines shall be of a continuous rod type, capable of holding a minimum of 1000 feet of rod. The rod shall be specifically treated steel. The machine shall have a positive rod drive and produce a

2000 pound rod pull. To insure safe operation, the machine shall have a fully enclosed body and an automatic safety throw-out clutch.

5. Cleaning equipment shall be provided that includes an air conveying vacuum system to provide for the simultaneous removal of the debris flushed to the manhole.
6. A temporary debris catcher, as approved by the Engineer, shall be used in the downstream manhole. See Standard Detail Drawings.

2.02 PERSONNEL

- A. Contractor personnel shall be thoroughly familiar with all phases of sewer line cleaning to insure satisfactory end results without causing damage to the sewer lines or adjacent property.

PART 3 - EXECUTION

3.01 CLEANING EQUIPMENT

- A. Since the success of related work depends a great deal upon the cleanliness of the lines, the importance of the cleaning operation cannot be too strongly emphasized. The equipment selected for cleaning shall be capable of removing all dirt, grass, rocks and other deleterious materials from the sewer lines and manholes. Particular emphasis is placed on the removal of grease accumulations so that cracks and breaks can be observed during television inspection and so that joints can be isolated during testing and sealing operations.
- B. The Contractor shall make an inspection of the lines to be cleaned in order to determine the type of cleaning equipment that is required. It is anticipated that hydraulic cleaning will be adequate for most of the line segments.

3.02 CLEANING REQUIREMENTS

- A. Prior to inspection, the designated sewer lines, as shown on the project drawings, will be thoroughly cleaned as specified below:
 1. The sewer lines shall be cleaned by using standard mechanically powered or hydraulically propelled cleaning tools or combinations thereof, such as rodding machines, boring machines, hydraulic balls, cones, ferrets, or other similar devices.
 2. All roots, sludge, dirt, sand, rock, grease and other solid or semi-solid material resulting from the cleaning operations shall be removed at the downstream manhole without passing the material from section to section, which could cause stoppage of the lines or accumulation in the wet well

and damage to pumping equipment. When cleaning equipment is used, a debris catch riser as shown in the standard details shall be used in the downstream manhole so that both solids and water shall be trapped. All solids or semi-solids resulting from the cleaning operations shall be removed from the site and disposed of at no additional cost to the Owner. It the responsibility of the Contractor to secure a legal dump site for the disposal of this material.

3. Satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by the improper use of cleaning equipment. Whenever hydraulically propelled cleaning tools, which depend upon water pressure to provide their cleaning force or any tools which retard the flow of water in the sewer lines are used, precautions shall be taken to insure that the water pressure created does not cause any damage or flooding to public or private property being served by the manhole section involved. The flow of sewage present in the sewer lines shall be utilized to provide necessary fluid for hydraulic cleaning devices whenever possible. When additional quantities of water from fire hydrants are necessary to avoid delay in normal working procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed or used when there is a fire in the area. Before using any water from the City water supply system, the Contractor shall obtain a hydrant meter from the Meter Department. The Contractor shall be responsible for the water meter and related charges for the set up, including the water usage bill. All expenses shall be considered incidental to cleaning.
4. **UNDER NO CIRCUMSTANCES SHALL SEWAGE OR SOLIDS REMOVED THEREFROM BE DUMPED ONTO STREETS OR INTO DITCHES, CATCH BASINS, STORM DRAINS OR SANITARY SEWER MANHOLES.**

END OF SECTION 5000

SECTION 5100

SEWER LINE TELEVISION INSPECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All new sewer lines constructed shall be inspected via internal television inspection.
- B. This section covers the television inspection of sewer lines.
 - 1. The inspection of each line shall be by a television (TV) camera especially designed to accurately show the condition of the lines from the interior and with the ability to pinpoint the locations of line faults and necessary repairs.
 - 2. A sewer line joint means the junction of two adjacent lengths of sewer pipe, and a fault is any crack too small to warrant pipe replacement. The term “manhole section” as used in these specifications shall mean the length of pipe connecting two manholes.

1.02 RELATED WORK

- A. Section 3100 – Installation of Sewer Pipe, Fittings, and Materials
- B. Section 3200 – Installation of Sewer Service Lines
- C. Section 5000 – Sewer Line Cleaning

1.03 SUBMITTALS

- A. The Contractor shall submit for approval manufacturer’s brochures and specifications for proposed TV equipment.

1.04 INSPECTION

- A. Immediately upon cleaning the sewer line in one location, it shall be televised to determine the condition of the line and location of existing service connections, etc.
- B. The sewer lines shall be visually inspected by TV camera. The section being inspected shall be suitably isolated from the remainder of the sewer line as necessary.

- C. The camera shall be moved through the line in either direction at a uniform slow rate not to exceed 60 feet per minute, by means of cable winches, or similar mechanisms. **Under no circumstances shall the camera be tethered to a hydraulically propelled or high-velocity jet cleaning device while the cleaning device is on.**
- D. The camera shall stop at each service connection and provide a view up the service line.
- E. Telephone, or similar suitable means of communications, shall be set up between the two winches, the pumping unit and the monitor control.
- F. Under certain conditions, it may be impossible for inspection equipment to pass through a manhole section due to damaged pipe or other obstructions not correctable by internal methods. In such cases, the Engineer will be notified.
- G. TV inspection will be done one manhole section at a time and the flow in the section being inspected will be suitably controlled. Sewer flow will not exceed those shown below as measured in the manhole:

6" - 10" Pipe	1 inch
12" - 14" Pipe	2 inches
14" - 24" Pipe	3 inches
Over 24" Pipe	4 inches
- H. The Contractor will make all provisions for pumping or bypassing the flow around the manhole section and the cost shall be incidental to TV inspection. Contractor shall not be allowed to float the camera unless permitted by the City.
- I. It is possible that some sections of the sewer line cannot be televised; therefore, house or building connection lines will have to be located on the ground by the Contractor. All cost for locating these service lines shall be included in the cost bid for house or building service line reconnection.

PART 2 - PRODUCTS

2.01 TELEVISION INSPECTION EQUIPMENT

- A. The television camera and monitoring equipment shall be specifically designed and constructed to perform the work as specified. The camera shall be operative in conditions of 100% humidity and/or under water. The camera shall be small enough to pass through a 6 inch diameter sewer and shall be waterproof with a self contained lighting system capable of producing enough light to produce clear, bright, sharp pictures on the monitor. The lighting and camera quality shall be suitable to allow a clear, in focus picture of a minimum of 6 linear feet of the

entire inside periphery of the sewer pipe. Picture quality and definition shall be to the satisfaction of Engineer; otherwise, the equipment shall be removed from the line without pay.

- B. The monitor shall be located within a temperature controlled television unit that will accommodate three people to watch the sewer line inspection. The monitor will have a 12-inch minimum viewing screen. The Engineer will have access to view the television monitor at all times.

PART 3 - EXECUTION

3.01 TELEVISION INSPECTION BY THE CONTRACTOR

- A. The Contractor shall furnish video media of the lines televised to the Engineer for review and comments, which may require up to thirty (30) calendar days from the date submittal to the City. The video media shall be DVD format. Video shall play in a standard DVD player without the need of viewing software. Each video media shall be permanently labeled with the following information furnished:
 - 1. Project Job Number
 - 2. Manhole to Manhole Designation
 - 3. Name of Contractor
 - 4. Date Televised
- B. The following information shall be recorded and visible onscreen for 10 seconds immediately before the start of televising each line segment:
 - 1. Project Job Number
 - 2. Manhole to Manhole Designation (Number, Pipe Material, Size of Line, and Direction of Televising)
 - 3. Name of Contractor
 - 4. Date Televised
 - 5. Street and or Easement Location
 - 6. Drawing Sheet Number
- C. A continuous uninterrupted recording of distance from the insertion manhole shall be visible at the lower left corner of the screen at all times during inspection.

- D. The following information shall be provided in hard copy to accompany each tape:
1. Project Job Number
 2. Name of Contractor
 3. Date Televised
 4. Street or Other Location
 5. Upstream Manhole Designation
 6. Downstream Manhole Designation
 7. Pipe Material
 8. Pipe Diameter
 9. Direction of Televising (Downstream or Upstream)
 10. Continuous Time Log Designating Start and Finish of Each Line Segment Televised. Time shall begin at 0hr 0min 0sec at the beginning of each tape.
 11. Location of Service Connections
- E. Media will become the property of the City. If the video is of such poor quality that the Engineer is unable to evaluate the condition of the sewer line or to locate service connections, the Contractor will be required to retelevising and provide a good video of the line at no additional cost to the City.

END OF SECTION 5100

SECTION 5200

INSPECTION AND TESTING OF SEWER LINES, MANHOLES, AND SERVICE LINES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the inspection and testing of sewer lines, manholes, and service lines. Holiday testing shall be required on all epoxy line manholes and sewer wet wells. Testing is required before final acceptance of sewer lines and service lines by the City.

1.02 RELATED WORK

- A. Section 3000 – Sewer Pipe, Fittings, and Materials
- B. Section 3100 – Installation of Sewer Pipe, Fittings, and Materials
- C. Section 3200 – Installation of Sewer Service Lines
- D. Section 3300 – Manholes
- E. Section 5100 – Sewer Line Television Inspection

1.03 SCOPE OF WORK

- A. All pipelines shall be inspected and tested before final acceptance. The methods to be used are as follows:
 - 1. New Gravity Sewer Lines
 - a. Visual inspection during installation and before backfill.
 - b. Low pressure air test.
 - c. Television inspection.
 - d. Mandrel test (Flexible pipes only)
 - e. Final Visual Inspection
 - f. Infiltration/exfiltration
 - g. Tracer wire continuity test.
 - 2. Manholes
 - a. Visual inspection during installation and before backfill.
 - b. Vacuum testing.
 - c. Final visual inspection.
 - d. Holiday test (epoxy coatings).

3. Replacement Sewer Lines and Point Repairs
 - a. Visual inspection during installation and before backfill.
 - b. Low pressure air test/exfiltration, infiltration.
 - c. Television inspection.
 - d. Mandrel test.
 - e. Final visual inspection.
4. Force Mains
 - a. Visual inspection during installation and before backfill.
 - b. Hydrostatic pressure test.
 - c. Tracer wire continuity test.
5. Service Lines
 - a. Visual inspection during installation and before backfill.
 - b. Low pressure air test.
 - c. Exfiltration test.

1.04 DELIVERABLES

- A. **The Engineer shall provide a complete and comprehensive testing report summary complete with all inspection and testing dates and results.**

PART 2 - PRODUCTS

- A. Not Used.

PART 3 - EXECUTION

3.01 VISUAL INSPECTION DURING INSTALLATION AND BEFORE BACKFILL

- A. The Engineer shall be responsible for inspecting sewer lines, manholes, and service lines during all phases of construction. The Engineer shall provide full time inspection services. All work not conforming to these specifications that is discovered during this inspection phase will be corrected by the Contractor.

3.02 PRESSURE TEST FOR GRAVITY SEWER PIPELINES

- A. The Contractor will perform pressure tests on all gravity sewer lines.
- B. Lines will not be accepted until they pass all required tests.
- C. Perform the tests in the presence of the City representative. Provide at least 48 hours notice before beginning testing.
- D. The primary test method is the Low Pressure Air Loss test.

3.03 LOW PRESSURE AIR LOSS PROCEDURE FOR GRAVITY SEWER PIPELINES

- A. Plug all pipe outlets with suitable test plugs. Brace each plug securely.
- B. Pipe air supply to pipeline to be tested so that air supply may be shut off, pressure observed, and air pressure released from the pipe without entering the manhole. Install a valved branch in the supply line past the shut-off valve terminating in a 1/4" female pipe thread for installation of the test gauge.
- C. Add air slowly to portion of pipe under test until test gauge reads at least 4 psig, but less than 5 psig.
- D. Shut air supply valve and allow at least two minutes for internal pressure to stabilize.
- E. The pressure shall then be decreased to 3.5 psig.
- F. Upon reaching 3.5 psig, the time in minutes.seconds for the pressure to fall 1 psig so that pressure at the end of time of the test is at least 2.5 psig shall be observed.
- G. Compare observed time with minimum allowable times in the following chart for pass/fail determination.

TEST CHART FOR AIR TESTING SEWERS Leakage Testing of Sewers by Low Pressure Air Loss (Time Pressure Drop Method)

Table 1 - Minimum Test Times in Minutes.Seconds for 1 psig drop (3.5 psig to 2.5 psig)										
Distance Between Manholes	Nominal Pipe Diameter (inches)									
	8	10	12	15	18	21	24	30	36	42
100	7.33	9.26	11.20	14.10	17.00	19.49	22.47	35.36	51.17	69.48
150	7.33	9.26	11.20	14.10	17.00	26.1	34.11	53.25	76.55	104.42
200	7.33	9.26	11.23	17.48	25.38	34.54	45.35	71.13	102.34	139.36
250	7.33	9.53	14.14	22.15	32.03	43.37	56.59	89.02	128.12	174.3
300	7.35	11.52	17.05	26.42	38.27	52.21	68.22	106.5	153.51	209.24
350	8.51	13.51	19.56	31.09	44.52	61.04	79.46	124.39	179.29	244.19
400	10.07	15.49	22.47	35.36	51.17	69.48	91.10	142.27	205.08	279.13
450	11.23	17.48	25.38	40.04	57.41	78.31	102.34	160.16	230.47	314.07
500	12.39	19.47	28.29	44.31	64.06	87.15	113.58	178.04	256.25	349.01
550	13.55	21.45	31.20	48.58	70.31	95.58	125.21	195.52	282.04	383.55
600	15.11	23.44	34.11	53.25	76.55	104.42	136.45	213.41	307.42	418.49

- H. Where groundwater level is above the crown of the pipe being tested, increase test pressure at the rate of 1 psi for every 2.5 feet of water above the crown.
- I. Air Testing Safety Requirements:
 - 1. Securely brace plugs used to close the sewer pipe for the air test; this is to prevent the unintentional release of a plug which can become a high velocity projectile. For example: four pounds (gauge) air pressure develops a force against the plug in a 12" diameter pipe of approximately 450 pounds; this force can propel a 12-inch plug weighing 10 pounds to supersonic speeds.
 - 2. Locate gauges, air piping manifolds, and valves at the top of the ground. Entry by anyone into a manhole where a plugged pipe is under pressure is strictly prohibited.

3.04 HOLIDAY TESTING FOR EPOXY LININGS

- A. High voltage holiday detection for coating systems installed in corrosive environments, when it can be safely and effectively employed, shall be performed to ensure monolithic protection of the substrate. After the coating product(s) have cured in accordance with manufacturer recommendations, all surfaces shall be inspected for holidays in accordance with NACE RPO 188-99, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates. All detected holidays shall be marked and repaired according to the coating product(s) manufacturer's recommendations.
- B. Test voltage shall be a minimum of 100 volts per mil of coating system thickness.
- C. Detection of a known or induced holiday in the coating product shall be confirmed to ensure proper operation of the test unit.
- D. All areas repaired shall be retested following cure of the repair material(s).
- E. In instances where high voltage holiday detection is not feasible a close visual inspection shall be conducted and all possible holidays shall be marked and repaired as described above.
- F. Documentation of areas tested, equipment employed, results, and repairs made shall be submitted to the City/Engineer by Contractor.

3.05 TELEVISION INSPECTION

- A. The Contractor shall televise all newly installed sewer mains as follows:
 - 1. Television inspection shall be performed no less than 30-days after the pipe has been backfilled. Inspection shall be performed after mandrel testing, if applicable.
 - 2. The Contractor shall clean all lines thoroughly prior to the start of televising.
 - 3. Prior to performing the video test, a 5 gallons of clean water per 100 feet of sewer line shall be poured down the sewer main in order to highlight low spots.
 - 4. The Contractor shall televise each segment of pipe.
 - 5. The Contractor shall review the video for possible defects in material or workmanship.
 - 6. The Contractor shall correct any defects discovered during the television inspection at the Contractor's expense.
 - 7. The Contractor shall deliver to the Engineer final video and logs after all defects have been repaired.

3.06 MANDREL TEST

- A. Mandrel testing shall be performed no less than 30-days after the pipe has been backfilled.
- B. The maximum allowable pipe deflection is five (5) percent of the inside pipe diameter.
- C. Any sewer pipe which fails the mandrel test prior to final acceptance will not be accepted by the City until the defects are corrected.
- D. All mandrel tests shall be performed by the Contractor while observed by City personnel.

3.07 SUPPLEMENTAL MANDREL TESTING

- A. The City may at any time after final acceptance perform supplemental mandrel testing on pipelines constructed of flexible pipe material. These supplemental tests will be performed as detailed above with a maximum allowable long term deflection of five percent (5%).
- B. Any sewer pipe which fails the mandrel test prior to expiration of the maintenance bond will be corrected by the Contractor at the Contractor's expense. If the Contractor fails to correct these defects after a reasonable time, the City will correct the defects and file a claim with the bonding company.

3.08 FINAL VISUAL INSPECTION

- A. Upon completion of the above tests the Engineer will perform a final visual inspection of sewer lines and manholes.
- B. A punch list of defects (including obvious running leaks) will be prepared and sent to the Contractor for correction at the Contractors' expense.

3.09 INSPECTION FOR SERVICE LINES

- A. All building sewer installations shall be inspected and approved by an authorized City inspector.
- B. Backfill may only be placed on the completed portions of a building sewer following inspection. No approval certificate shall be issued until all portions of a building sewer from the main connection to the building foundation have been inspected and approved by an authorized inspector. At the time of inspection, the pipe should be in place in the trench and "safed-up", but the top half of the pipe barrel exposed. No approval will be given for building sewers all or a portion of which are covered at the time of inspection.
- C. All building sewers are subject to testing to insure water tightness. All tests must be performed in the presence of the Engineer. Tests may be either by:
 - 1. Water Loss Test Procedure; or,
 - 2. Low Pressure Air Loss Procedure.
- D. If, in the opinion of the Engineer, the line in question is properly installed and free from open joints and breaks, building sewers constructed entirely of cast iron soil pipe may be connected to the city sewer without testing.
- E. Low Pressure Air Loss Procedure
 - 1. Plug securely both ends of the line to be tested.
 - 2. Charge the line with air to a pressure of 4.5 psig.
 - 3. Allow at least five minutes for the temperature in the pipe to stabilize.
 - 4. Measure the time required for a one (1.0) psi drop in pressure.
 - 5. The minimum time for a one psi loss is $28.5 \times d$ seconds where d = the nominal diameter in inches of the pipe being tested.

3.10 PRESSURE TEST FOR FORCE MAINS

- A. Perform hydrostatic leakage tests for force mains the same as water pipe, see Section 5300, by filling the force main with water and increasing the pressure to a testing pressure of 150% of the working pressure with a minimum of 100 psi and a maximum pressure of 250 psi.
- B. The duration of the leakage test shall be two hours.
- C. **The maximum allowable leakage rate shall be 1 gallon per foot diameter of pipe per 1000 feet of force main for the duration of the 2 hour test.**
- D. The force main will not be accepted until the actual leakage is equal to or less than the allowable. In addition, all obvious leaks shall be repaired.

3.11 MANHOLE TESTING

- A. The Contractor shall vacuum test all new manholes constructed.
- B. Precast manholes shall be vacuum tested prior to backfill.
- C. The Contractor shall vacuum test all manholes that have been sealed (waterproofed).
- D. The Contractor shall vacuum test all manholes that have been epoxy lined.
- E. Manholes shall be tested in accordance with ASTM C 1244, latest edition. Vacuum test shall not be performed earlier than 7 days after construction for cast in place manholes. The Contractor shall provide all testing equipment, pump, hosing, seal, and other incidentals. Vacuum test head shall be positioned at the top of the casting (the surface on which the manhole cover rests, to include grade rings) in accordance with the equipment manufacturer's instructions. A vacuum of 10-inches of mercury shall be drawn and the vacuum pump isolated by the shut-off valve on the test head connection. When valve is closed, time measurement shall commence, and the time required for vacuum drop to 9-inches of mercury shall be observed and recorded. Manholes shall pass if the time for the vacuum reading to drop from 10-inches of mercury to 9-inches of mercury meets or exceeds the time values in seconds in the following table.

Table 2 - Minimum Test Times for Various Manhole Diameters (seconds)									
Depth (feet)	Diameter (inches)								
	30	33	36	42	48	54	60	66	72
<10	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	57	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	70	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

- F. Manholes showing greater than the allowable leakage shall be repaired and re-tested until a satisfactory leakage result is obtained.

3.12 TRACER WIRE CONTINUITY TESTING

- A. Contractor shall perform a continuity test on all tracer wire in the presence of the Engineer or the Engineers' representative. If the tracer wire is found to be not continuous during testing, Contractor shall repair or replace the failed segment of wire at their own expense.
- B. A final continuity test shall be performed by a Water and Sewer Department representative before the project will be accepted by the City. If the tracer wire is found to be not continuous during testing, Contractor shall repair or replace the failed segment of wire at his own expense.

END OF SECTION 5200

SECTION 5300

INSPECTION AND TESTING OF WATER LINES AND SERVICE LINES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the inspection and testing of water lines and services lines. Testing is required before final acceptance of water lines and service lines by the City.

1.02 RELATED WORK

- A. Section 4000 – Water Pipe, Fittings, and Materials
- B. Section 4100 – Installation of Water Pipe, Fittings, and Materials

1.03 SCOPE OF WORK

- A. All pipelines shall be inspected and tested before final acceptance. The methods to be used are as follows:
 - 1. New Water Pipelines
 - a. Visual inspection during installation and before backfill.
 - b. Hydrostatic pressure test.
 - c. Disinfection.
 - d. Bacteriological sampling.
 - e. Final Visual Inspection.
 - f. Tracer wire continuity test.
 - 2. Water Meter Setters
 - a. Visual inspection during installation and before backfill.
 - b. Final Visual Inspection.
 - 3. Service Lines
 - a. Visual inspection during installation and before backfill.
 - b. Hydrostatic pressure test.
 - c. Final Visual Inspection
 - d. Tracer wire continuity test.

1.04 DELIVERABLES

- A. The Engineer shall provide a complete and comprehensive testing report summary complete with all inspection and testing dates and results.

PART 2 - PRODUCTS

- A. Not Used.

PART 3 - EXECUTION

3.01 VISUAL INSPECTION DURING INSTALLATION AND BEFORE BACKFILL

- A. The Engineer shall be responsible for inspecting water lines, water meter setters, and service lines during all phases of construction. The Engineer shall provide full time inspection services. All work not conforming to these specifications that is discovered during this inspection phase will be corrected by the Contractor.

3.02 PRESSURE TEST FOR TAPPING SLEEVES

- A. The contractor shall provide all pumps or other equipment necessary to test the tapping sleeve before making a tap. The duration of the hydrostatic leakage test on tapping sleeves shall be thirty (30) minutes at 225 psi with zero leakage.

3.03 PRESSURE TEST FOR WATER PIPELINES AND SERVICE LINES

- A. After completion of construction of all water lines or sections thereof, the Contractor shall flush, test and disinfect the new water lines and in accordance with the Engineer of Record's plan as described below.
- B. Flushing
 - 1. All water for flushing, testing and disinfecting water lines shall be supplied and paid for by the Contractor. Water meters shall be obtained from the City of Fayetteville Meter Division. Water used for high rate flushing shall not be metered through a contractor issued water meter. Actual water flow rates used during flushing operations shall be determined by the City of Fayetteville by using either pitot style gauges or high rate water meters. Volume shall be determined by multiplying the measured flow rate times the duration of flushing in minutes. Water used for flushing shall be billed to the contractor at the current wholesale water rate plus applicable taxes.
 - 2. The work shall be coordinated to ensure that it will not be carried on during periods of high water usage. Water valves or other appurtenances on the existing water system, new tapping valves, or valves or

appurtenances that have been accepted by the City, shall only be operated by, or under the direct supervision of, the City of Fayetteville Water & Sewer Maintenance Division.

3. The Contractor shall fill and flush the newly constructed lines and visually check all combination air release and vacuum valves, blow-off valve assemblies, line valves, fire hydrants, and meter setters to assure proper operation.
4. The Engineer of Record shall develop a flushing plan to ensure that all lines are properly flushed. The plan should specify the sequence in which valves and hydrants are to be opened and the duration thereof, ensuring complete flushing and protecting the City's water system from construction contaminated water. The volume to be flushed shall be no less than three (3) but no more than five (5) times the volume of the main to be flushed, and shall be metered by the City. The flow shall be such that a flushing velocity of not less than 2.5 feet per second and preferably 3.5 feet per second or greater is attained.

C. Hydrostatic Testing

1. All pipe shall be tested as set out in AWWA C600, latest revision. Tests will be conducted only after the line is completed, including all taps and meter settings as required and the backfill completed. These tests shall be performed by the Contractor in the presence of the City Inspectors and the Engineer of Record. The Contractor shall furnish all necessary pressure gauges, meters, and pumps and make all taps and connections.
2. Each valved section of pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. Before applying the test pressure, all air shall be expelled from the pipe by permanent taps or corporation cocks where necessary.
3. Test pressure shall be either 150 percent of the static pressure at the lowest points or 200 psi, whichever is greater, not to exceed 250 psi at the lowest point. The contractor shall provide all pumps or other equipment necessary to maintain the test pressure within ± 5 psi at the test point for a period of two (2) hours. All interior valves including guardian valves on fire hydrants and other appurtenances shall be open during all tests.
4. The test pressure shall not vary by more than \pm five (5) psi for the duration of the test. During the duration of the two hour test, if the test pressure drops more than 5.0 psi from the start pressure, the test shall be terminated and considered failure due to assumed leaks in the tested pipe section. If

the pressure rises beyond the allowed 5 psi variance, the test shall be terminated and remaining air shall be purged from the pipeline.

D. Leakage

1. The leakage test shall be conducted concurrently with the pressure test. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the above specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
2. **The maximum allowable leakage rate shall be 1 gallon per foot diameter of pipe per 1000 feet of water line for the duration of the 2 hour test.**

D (inches)	6	8	10	12	14	16	18	20	24	36	42
Allowable	0.50	0.67	0.83	1.00	1.17	1.33	1.50	1.67	2.00	3.00	3.50

3. Upon completion of a two hour test where the test pressure did not vary by more than \pm five (5) psi, the CONTRACTOR shall determine the leakage amount by measuring the amount of “make-up” water necessary to restore the original starting pressure.
4. Should any test of pipe laid disclose leakage greater than that specified, the leak(s) shall be located and repaired and the line shall be re-tested at the Contractor’s expense. **All visible leaks shall be repaired regardless of the amount of leakage.** It may be necessary to utilize leak detection equipment to locate not visible leaks at the Contractor’s expense.

3.04 DISINFECTION

- A. After successful pressure testing, the line(s) shall be flushed at a velocity equal to or greater than 2.5 feet per second. The line shall then be disinfected in accordance with AWWA C651, latest revision, for Disinfecting Water Mains, continuous feed method, except that the placing of hypochlorite granules into the main during construction will not be permitted.
- B. The Contractor shall provide a test/chlorine tap no greater than 10’ downstream from the beginning of the new water line. All excavation, installation, use of and proper abandonment of the test tap is the responsibility of the Contractor.
- C. The final concentration of chlorine inside the main shall be 25 parts per million (ppm) at all locations and shall be maintained for a minimum of 24 hours. The chlorine residual at the end of the 24 hour period shall not be less than 10 ppm. The contractor shall supply all test kits necessary to verify chlorine concentrations.

- D. The contractor shall operate all valves and hydrants in the treated section of water line during the initial 24 hours to ensure disinfection of the appurtenances.
- E. The contractor shall take great care when flushing the line to assure proper drainage is available to prevent harm at any adjacent downstream location.
- F. Disposal of the disinfecting water shall be in a manner that will protect the public and the receiving waters from harmful concentrations of chlorine. Dechlorination of the disinfecting water shall be in accordance with AWWA C655, Field Dechlorination, latest edition. A dechlorination plan shall be prepared by the Engineer of Record.
- G. After disinfection is complete, the Contractor shall then flush the disinfecting solution from the lines to a point that the chlorine concentration is back down to the same level as the treated water from the distribution system. The treated water lines will then be tested before being placed into service.

3.05 BACTERIOLOGICAL SAMPLES

- A. Bacteriological samples shall be taken by City personnel only. Samples shall be taken on two consecutive days and shall be taken only on Monday, Tuesday, Wednesday, or Thursday. Before a line is placed in service, two consecutive series of samples which are not collected on the same day and are taken no more than 4 days apart must show that the water is bacteriologically safe for drinking purposes.

3.06 FINAL VISUAL INSPECTION

- A. Upon completion of the above tests the Engineer will perform a final visual inspection of water pipelines and meters.
- B. A punch list of defects (including obvious running leaks) will be prepared and sent to the Contractor for correction at the Contractors' expense.

3.07 TRACER WIRE CONTINUITY TESTING

- A. Contractor shall perform a continuity test on all tracer wire in the presence of the Engineer or the Engineers' representative. If the tracer wire is found to be not continuous during testing, Contractor shall repair or replace the failed segment of wire at their own expense.
- B. A final continuity test shall be performed by a Water and Sewer Department representative before the project will be accepted by the City. If the tracer wire is found to be not continuous during testing, Contractor shall repair or replace the failed segment of wire at his own expense.

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END OF SECTION 5300

SECTION 6000

PAVEMENT REPAIR

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the materials and procedures used in the repair of roads, streets, or other public rights-of-way where a water lines, sewer line, or structure is constructed.

1.02 RELATED WORK

- A. Section 2300 - Excavation, Backfilling and Compacting.

1.03 REGULATIONS AND STANDARDS

- A. All permanent repairs of streets, roads, sidewalks, other public rights-of-way, private drives, private parking lots, etc. shall comply with the requirements shown on the Standard Detail Drawings and Tables. The Contractor is responsible for following the requirements of all local Ordinances, Regulations, or Codes governing the repairs to roads, streets, or other public rights of way. In particular:
 - 1. Repair of State Highways: per requirements of the Arkansas State Highway Commission.
 - 2. Repair of county roads: per requirements of the County Roads Department.
 - 3. Repair of City of Fayetteville streets, sidewalks, and driveways: per the requirements of the City of Fayetteville
 - 4. Permit for street cut and repairs shall be furnished by the Contractor.
- B. Temporary Repairs: Per requirements of the governmental agency having jurisdiction and these specifications. Must provide a minimum of a cold mix temporary patch.

1.04 TESTING, OBSERVATION, AND INSPECTION REQUIREMENTS

- A. Testing and inspection is required for pavement repairs in accordance with all local Ordinances, Regulations, or Codes governing the repairs. The inspection of street repairs shall be coordinated with the City of Fayetteville to ensure compliance with all applicable standards.

- B. The Engineer shall provide a Construction Observer that will be on-site during the construction of pavement repairs.
- C. The Contractor shall provide an on-site representative that is qualified and experienced in job superintendence. If the Contractor's representative is not on-site, the Engineer may order all work be stopped until such time as the Contractor's superintendent returns to the job site.
- D. The Contractor shall provide at least 24 hours of advance notice for any concrete or asphalt placement. Unless otherwise specified, the Contractor shall provide, at its expense, an independent quality assurance/quality control (QA/QC) laboratory to accomplish quality assurance testing. All testing will be scheduled with the QA/QC lab by the Contractor and coordinated with the Engineer.
- E. The Contractor shall provide or make available samples of all material as required by these specifications as well as any other materials deemed necessary by the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Per the applicable standards referenced above.

PART 3 - EXECUTION

3.01 ASPHALT PAVEMENT REPAIRS

- A. Asphalt pavement shall be replaced in accordance with details shown on the Drawings and all materials shall be furnished and installed in accordance with the Arkansas Highway and Transportation Department "Standard Specifications for Highway Construction." Before replacing paved surfacing, the existing pavement shall be cut, sawed, or trimmed along straight and vertical lines. The condition of the backfill and base course material, with special regard to the degree of compaction, may be checked and approved by the City of Fayetteville before any surfacing is replaced.
- B. All street repairs shall require a "tee" patch, a minimum of 2' wider than the trench width in accordance with the Standard Details.
- C. Trenches shall be backfilled with Class 7 base material compacted to 95% Modified Proctor Density.

- D. Before placement of new surface material, all excess material shall be removed to a minimum depth of nine (9) inches. A minimum of six (6) inches of 3,000 psi concrete shall be placed within three (3) inches of the street surface. Before placing asphalt, the concrete and sides of the cut shall be primed with MC-30 at the rate of 0.3 gallon per square yard.
- E. Minimum thickness of asphalt surface replacement shall be three (3) inches, unless shown otherwise. Hot mix asphalt material shall be delivered to the site in covered vehicles, at 275 deg-F (minimum), and immediately spread to a thickness to match adjacent surfaces after rolling. Compaction shall be by steel-wheel roller to a smooth, uniform surface matching adjacent surfaces.
- F. Paved parking lots disturbed or damaged in the process of construction shall be replaced in kind. Parking lots shall be replaced to same thickness as original but in no case less than 4-inches thick. Joint system in replacement shall be at same style and interval as that in the undisturbed parking lot.
- G. Any settlement or failure of surface replacement shall be repaired or replaced by the Contractor.
- H. All pavement repairs shall be in accordance with the Standard Details.
- I. All pavement markings shall be restored to new conditions per the requirements of the governmental agency having jurisdiction.

3.02 CONCRETE PAVEMENT REPAIRS

- A. Concrete pavement shall be replaced in accordance with details shown on the Drawings and all materials shall be furnished and installed in accordance with the Arkansas Highway and Transportation Department "Standard Specifications for Highway Construction." Before replacing paved surfacing, the existing pavement shall be cut, sawed, or trimmed along straight and vertical lines. The condition of the backfill and base course material, with special regard to the degree of compaction, may be checked and approved by the City of Fayetteville before any surfacing is replaced.
- B. All street repairs shall require a "tee" patch, a minimum of 2' wider than the trench width in accordance with the Standard Details.
- C. Trenches shall be backfilled with Class 7 base material compacted to 95% Modified Proctor Density.
- D. Before placement of concrete street material, all excess material shall be removed to a minimum depth of eight (8) inches. A minimum of eight (8) inches of 4,000 psi concrete shall be placed to match the line and grade of existing street surface.

- E. Paved walkways disturbed or damaged in the process of construction shall be replaced in kind. Walkway shall be replaced to same width and thickness as original but in no case less than 4-inches thick. Joint system in replacement shall be at same style and interval as that in the undisturbed walkway.
- F. Paved driveways disturbed or damaged in the process of construction shall be replaced in kind. Driveway shall be replaced to same width and thickness as original but in no case less than 4-inches thick. Joint system in replacement shall be at same style and interval as that in the undisturbed driveway.
- G. Paved parking lots disturbed or damaged in the process of construction shall be replaced in kind. Parking lots shall be replaced to same thickness as original but in no case less than 4-inches thick. Joint system in replacement shall be at same style and interval as that in the undisturbed parking lot.
- H. All pavement repairs shall be in accordance with the Standard Details.
- I. All pavement markings shall be restored to new conditions per the requirements of the governmental agency having jurisdiction.

3.03 GRAVEL SURFACING

- A. Trenches shall be backfilled with Class 7 base material compacted to 95% Modified Proctor Density.
- B. Gravel surfacing shall be replaced to at least the compacted thickness of the original surface. All excavated material shall be removed from gravel surfaces affected by construction and sufficient new gravel material shall be placed to restore the original surfaced area. Minimum gravel thickness shall be three (3) inches.
- C. Gravel material for placement of "gravel" surfaced areas, shall be Class 7 material conforming to the Standard Specifications of the Arkansas Highway & Transportation Department, latest edition, and compacted to 95% Modified Proctor Density.

3.04 TEMPORARY SURFACING

- A. Comply with the requirements stated above or as otherwise approved to adequately maintain traffic and proper drainage.

3.05 TRAFFIC CONTROL

- A. Whenever traffic flow restrictions of any kind are anticipated, the Contractor will be required to contact the City of Fayetteville to be given permission to obstruct traffic flow.

- B. Street closing permits must be obtained from proper government agencies.
- C. Construction signs shall be placed immediately adjacent to the Work, at such locations as traffic demands.
- D. Contractor will be required to submit a barricade plan to City of Fayetteville and the Engineer.

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END OF SECTION 6000

SECTION 6100

LAWN AND GRASS RESTORATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This Section covers the replacement of sod in lawns disturbed by the construction.
- B. Consists of furnishing and applying fertilizer, seed, mulch cover, and water at all other locations disturbed by the construction.
- C. Maintenance service.

1.02 RELATED WORK

- A. Section 2300 - Excavation, Backfilling, and Compacting

1.03 SCOPE OF WORK

- A. This Section covers the furnishing and placing of sod to form solid mats on areas shown on the Drawings (generally lawns or commercial green spaces) or seed and mulch all other areas disturbed by the Contractor.
- B. It covers the furnishing and applying of water.
- C. It covers the furnishing and placing of four (4) inches of topsoil on all areas disturbed during construction.
- D. It covers the furnishing and placing of fertilizer.
- E. All work shall be in accordance with details shown on the Drawings and within these Specifications.
- F. The Contractor is responsible for following the requirements of all local Ordinances, Regulations, or Codes governing re-vegetation and slope stabilization,

1.04 WARRANTY

- A. Provide one year warranty from date of final acceptance.
- B. Replace areas found dead, or not in a healthy growing condition.

PART 2 - PRODUCTS

2.01 TOPSOIL

- A. Topsoil shall be reasonably free from subsoil, clay, lumps, brush, objectionable weeds and/or other litter and shall be free from roots and toxic substances or other material or substances that might be harmful to plant growth or be a hindrance to grading, planting and maintenance operations.

2.02 FERTILIZER

- A. Fertilizer shall be a standard commercial product complying with State and Federal laws and with the requirements issued by proper authorities.
- B. Fertilizer shall be delivered to the site in the manufacturer's original container, on which shall be plainly marked the manufacturer's name and the guaranteed chemical analysis.
- C. Except as noted in the following sentence, fertilizer shall contain not less than the percentages by weight of ingredients as follows:

Nitrogen	- 13 percent
Phosphorus, P205	- 13 percent
Potash, K2	- 13 percent

Other 1:1:1 ratio fertilizers may be used, provided the available plant food remains the same as herein specified.

- D. All fertilizer shall be solid and shall be in a condition which will permit proper distribution.

2.03 SOD

- A. Solid sod shall be cut from well established viable Bermuda, Zoysia or St. Augustine grass. Sod type shall match that established in the disturbed areas.

2.04 SEED

- A. Contractor shall apply seed mixture appropriate for the season and disturbed area.
- B. Contractor shall apply a mixture of various annuals and perennials to provide overlapping times of seasonal peak vegetative cover. Seeding shall only be done just prior to the vegetation's peak season for best results. Seeding shall be used when there is sufficient time in the season to ensure adequate vegetation establishment and erosion control.

- C. To optimize soil stabilization, Contractor shall utilize a nurse crop of quick growing annuals within a mix of perennials appropriate for the season. The nurse crop germinates and grows rapidly, holding the soil until the slower-growing perennial seedlings become established. Permanent vegetation shall not be considered established until a ground cover of perennial vegetation is achieved that is uniform and mature enough to survive and be of sufficient density to preclude erosion.
- D. Contractor shall conduct seeding activities to achieve stabilization that are generally congruent with the following schedule:

Dormant Cold Season Temporary Stabilization (November 1 – February 28)

Seeding at this time of the year typically does not produce successful results, as cold temperatures inhibit seed germination. Contractor shall be responsible for achieving temporary stabilization via mulching, erosion control blankets, matting, compost, and/or other appropriate structural/nonstructural methods for temporary stabilization until seasonal weather conditions become more conducive to establishment of permanent perennial vegetative cover. Fertilizers shall be added at this time in preparation for seeding. Contractor shall be responsible for achieving temporary stabilization at all areas that are unstable and subject to erosion. Contractor shall apply temporary seeding, as follows:

Dormant Cool Season Temporary Cover Crop Seed Mix (November 1 – February 28)

Plant Species	Growth Season/ Life Cycle	Seeding Rate
Winter rye (<i>Secale cereale</i>)	cool season annual	75 lb/ac
Perennial Ryegrass (<i>Lolium perenne</i>)	cool season perennial	75 lb/ac

Pre Warm Season (Spring) Seeding (March 1 – May 31)

As the growing season approaches, Contractor shall apply a mix of quick germinating cool season species combined with warm season species listed below. The cool season species will serve to hold the soil until warmer weather arrives stimulating the warm season species to germinate.

Pre Warm Season (Spring) Seed Mix (March 1 – May 31)

Plant Species	Growth Season/ Life Cycle	Seeding Rate
Oats (<i>Avena sativa</i>)	cool season annual	20 lb/ac
Perennial Ryegrass (<i>Lolium perenne</i>)	cool season perennial	20 lb/ac
White clover (<i>Trifolium repens</i>)*	cool season perennial	20 lb/ac
Korean (Kobe) lespedeza (<i>Kummerowia stipulacea</i>)*	warm season annual	20 lb/ac
Bermuda (<i>Cynodon dactylon</i>)	warm season perennial	30 lbs/ac
Bahiagrass (<i>Paspalum notatum</i>)	warm season perennial	30 lbs/ac
Weeping love grass (<i>Eragrostis curvula</i>)	warm season perennial	30 lbs/ac

*All legume seed must be properly inoculated with appropriate inoculant.

Warm Season Seeding (June 1 – August 31)

In the midst of the growing season, Contractor shall apply a mix of warm season annuals and perennials, as follows:

Warm Season Seed Mix (June 1 – August 31)

Plant Species	Growth Season/ Life Cycle	Seeding Rate
Sudan grass (<i>Sorghum bicolor</i>)	warm season annual	20 lb/ac
Alyce clover (<i>Alysicarpus ovalifolius</i>)	warm season annual	20 lb/ac
Brown-top millet (<i>Panicum ramosum</i>)	warm season annual	20 lb/ac
Bermuda (<i>Cynodon dactylon</i>)	warm season perennial	25 lbs/ac
Bahiagrass (<i>Paspalum notatum</i>)	warm season perennial	25 lbs/ac
Weeping love grass (<i>Eragrostis curvula</i>)	warm season perennial	25 lbs/ac
Buffalo grass (<i>Bouteloua dactyloides</i>)	warm season perennial	25 lbs/ac

Late Season Seeding (September 1 – October 31)

During late summer to early fall, Contractor shall apply the following mix:

Late Season Seed Mix (September 1 – October 31)

Plant Species	Growth Season/ Life Cycle	Seeding Rate
Oats (<i>Avena sativa</i>)	cool season annual	30 lb/ac
Winter rye (<i>Secale cereale</i>)	cool season annual	30 lb/ac
White clover (<i>Trifolium repens</i>)*	cool season perennial	25 lb/ac
Perennial Ryegrass (<i>Lolium perenne</i>)	cool season perennial	50 lb/ac
Virginia wildrye (<i>Elymus virginicus</i>)	cool season perennial	25 lb/ac

*All legume seed must be properly inoculated with appropriate inoculant.

- E. Contractor has option of adding warm season perennials to Late Season Seed Mix (September 1 – October 31) and/or Dormant Cool Season Temporary Cover Crop Seed Mix (November 1 – February 28) or seeding with warm season perennials during other seeding periods. This is to be determined on a site-specific basis. Contractor shall confer with City of Fayetteville prior to seeding activities to determine specific seed mix.
- F. Contractor shall submit all labels/tags from seed bags and seed purchase invoices to the City of Fayetteville.

2.05 MULCH

- A. Mulching shall be used in conjunction with both temporary and permanent seeding practices to enhance their success by providing erosion protection prior to the onset of vegetative growth. Straw mulching shall be of oat, wheat, or rice straw mulch. Hay mulch shall be prairie grass, Bermuda grass, or other hay as approved. Mulch shall be dry and reasonably free from Johnson grass or other noxious weeds, and shall not be excessively brittle or in an advanced state of decomposition. All material will be inspected and approved prior to use.

- B. Mulching shall be spread in a uniform continuous blanket, at a rate of 1 to 3 tons per acre (air dried weight) or to a uniform 2-inch depth. Mulch shall be spread by hand or by an approved blower type mulch spreader. Care shall be taken to remove all wire and/or twine from baled hay/straw when the control structures are removed from the site. Mulch shall be anchored in the soil to a depth of two to three inches to form a soil-binding mulch to prevent loss or bunching, or held in place with a tackifier.

2.06 WATER

- A. Water shall be free from any substances, in solution or in suspension, which would inhibit the rapid growth of grass.

PART 3 - EXECUTION

3.01 FERTILIZER APPLICATION

- A. Fertilizers shall be applied at appropriate agronomic rate. If necessary to achieve final stabilization, fertilizer shall be applied at a minimum rate of 250 pounds per acre (0.0057 pounds per square foot) in advance of tilling/seedbed preparation operations. When soil samples are not practical, fertilizer shall consist of 13-13-13 (nitrogen, phosphorus, and potassium content). The fertilizer distributor box shall be equipped with baffle plates to prevent downward movement of fertilizer when operating on a slope. The fertilizer shall be raked in and thoroughly mixed with the soil to a depth of approximately 2 inches prior to the application of seed or mulch.

3.02 SEEDING

- A. Areas to be seeded shall be dressed to natural shape.
- B. The Contractor shall obtain an approved topsoil from any available source and place uniformly on the designated areas and spread evenly to a minimum thickness of four (4) inches. Irregularities in the surface shall be corrected so as to prevent formation of depressions where water will stand. TOPSOIL SHALL NOT BE PLACED WHEN THE SUBGRADE IS FROZEN, EXCESSIVELY WET, OR IN A CONDITION DETRIMENTAL TO THE PROPOSED PLANTING AND PROPER GRADING.
- C. Broadcast sowing of seed may be accomplished by hand seeders or by approved power equipment. Either method shall result in uniform distribution and no work shall be performed during high winds. The area seeded shall be lightly firmed with a cultipacker immediately after broadcast.
- D. The contractor shall water and maintain seeded areas from time of completion until final acceptance of the project.

- E. The contractor shall be responsible for establishing ground cover on all disturbed areas. Repeated seeding shall be required if necessary throughout the warranty period.

3.03 SOD PLACEMENT

- A. In this paragraph, "Solid Sod" is interchangeable with the word "sod."
- B. Solid sod or topsoil shall not be placed until all other items of work are complete.
- C. Prior to placing the sod and topsoil in the areas designated, the ground surface shall be cleared of materials that might hinder proper grading, tillage, or subsequent maintenance operations such as stumps, stones, roots, cable, wire, grade stakes, etc., and brought to four (4) inches below the finished grade. The areas shall then be thoroughly tilled to a depth of at least two (2) inches by plowing, disking, harrowing or other acceptable means.
- D. The Contractor shall then obtain an approved topsoil from any available source and place uniformly on the designated areas and spread evenly to a minimum thickness of four (4) inches. Irregularities in the surface shall be corrected so as to prevent formation of depressions where water will stand. TOPSOIL SHALL NOT BE PLACED WHEN THE SUBGRADE IS FROZEN, EXCESSIVELY WET, OR IN A CONDITION DETRIMENTAL TO THE PROPOSED PLANTING AND PROPER GRADING.
- E. After the topsoil has been spread and graded, the surface shall be cleared of stones, stumps or other objects that might hinder planting or maintenance preparations. Paved areas over which hauling operations are conducted shall be kept clean.
- F. Where any portion of the surface becomes gullied or otherwise damaged, the affected areas shall be repaired to the aforementioned condition.
- G. Areas to be sodded shall be shaped in such manner that they will, after placement of sod, conform to the typical sections.

3.04 WATERING

- A. Prior to placement of seed or sod, areas shall be sprinkled with water sufficiently to make them moist, but not muddy. The initial application of water may be omitted if the area is sufficient moist from rainfall.
- B. Immediately following the placing and tamping of sod, the covered area shall be wetted thoroughly. **Subsequent applications of water shall be as required.**

- C. Immediately following the application of the mulch cover for seeding, water shall be applied in sufficient quantity to thoroughly moisten the soil to the depth of pulverization and then as necessary to germinate the seed and maintain growth.

3.05 COMPLETENESS

- A. The lawn and grass operations shall not be considered complete until a uniform (e.g., evenly distributed, without large bare areas) perennial vegetative cover with a density of 80% of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures.

3.06 INTERMITTENT CLEANUP

- A. Immediately following the lawn and grass restoration operations, all gutters, sidewalks, driveways, street pavement, yard or other areas shall be cleaned of all debris, excess sod, topsoil or other objectionable matter. All such cleanup operations shall be completed before sodded areas are measured for payment.

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END OF SECTION 6100

SECTION 6200
REPORTING FORMS

Water Line Data

City of Fayetteville

[illegible]

Water Valve Data

City of Fayetteville

[illegible]

Fire Hydrant Information Sheet

City of Fayetteville

Hydrant ID:

Assigned by Water/Sewer

Manufacturer:

Mueller, Waterous, Other

Address:

Nearest House Number

Model:

Street:

Street Name

Year:

Cross Street:

Nearest Cross Street

Installation Date:

Main Diameter:

Installed By:

City or Contractor Name

Feeder Diameter:

Static Pressure:

 psi

Depth of Bury:

Include Extensions

Ownership:

City, Private, WWA, Other

Number of Nozzles:

 3 2 Other:

Nozzle Diameters:

 4 1/2"- ; 2 1/2"- ; Other-

Fire Flow Data

Secondary Fire Hydrant for Test

Pitot Pressure:

 psi

Hydrant ID:

Measured Flow:

 gpm

Static Pressure:

 psi

20 psi Residual Flow:

 gpm

Residual Pressure:

 psi

Current Color:

 Blue Green Orange Red Other:

Residual Flow is 1500 gpm > - Blue; 1000 to 1499 - Green; 500 to 999 - Orange; < 500 - Red

Correct Color:

Date of Flow Test:

Initials of Testor:

Date of Inspection:

Initials of Inspector:

Date of Maintenance:

Intitials of Maint.:

Notes:

Water Pressure and Leakage Test Form

City of Fayetteville

Test Date: _____					Contractor / Superintendent: _____				
Project Name: _____					_____				
City Project Number: _____					Engineer / Inspector: _____				
Location: _____					_____				
Pipe Diameter (inches)	Total Length of Pipe (feet)	Test Pressure (psi)	Allowable Leakage (gallons)	Start Time	Start Pressure (psi)	End Time	End Pressure (psi)	Make-up Volume (gallons)	Pass or Fail

D (inches)	Allowable per 1000'
6	0.50
8	0.67
10	0.83
12	1.00
14	1.17
16	1.33
18	1.50
20	1.67
24	2.00
36	3.00
42	3.50

City of Fayetteville

Water Line Flushing Form

City of Fayetteville

Test Date: _____				Contractor / Superintendent: _____			
Project Name: _____				_____			
City Project Number: _____				Engineer / Inspector: _____			
Location: _____				_____			
Pipe Diameter (inches)	Total Length of Pipe (feet)	Volume (gallons)	Start Time	Flushing Rate min. 2.5 fps (gpm)	Measured Flushing Rate (gpm)	End Time	Volume (gallons)

Diameter (inches)	Volume (1000')	gpm at 2.5 fps
2	163	24
3	367	55
4	653	98
6	1469	220
8	2611	392
12	5875	881

City of Fayetteville

Water Line Disinfection Form

City of Fayetteville

Test Date: _____					Contractor / Superintendent: _____		
Project Name: _____					_____		
City Project Number: _____					Engineer / Inspector: _____		
Location: _____					_____		
Pipe Diameter (inches)	Total Length of Pipe (feet)	Volume of Water (gallons)	Make-up Water Chlorine (ppm)	Chlorine Residual (ppm)	Date and Time	Chlorine Residual after 24 Hours (ppm)	Date and Time

After chlorine residual in the water line has been achieved at a minimum of 25 ppm, all valves and hydrants in the treated section of water line shall be operated during the initial 24 hours to ensure disinfection of the appurtenances.

Diameter (inches)	Volume (1000')
2	163
3	367
4	653
6	1469
8	2611
12	5875

City of Fayetteville

Sewer Line Mandrel Test Form

City of Fayetteville

Test Date: _____			Contractor / Superintendent: _____		
Project Name: _____			_____		
City Project Number: _____			Engineer / Inspector: _____		
Location: _____			_____		
Plan Sheet Number	Upstream Manhole	Upstream Sta. Number	Downstream Manhole	Downstream Sta. Number	Pass or Fail

Sewer Line Low Pressure Air Test Form

City of Fayetteville

Test Date:	Contractor / Superintendent:
Project Name:	
City Project Number:	Engineer / Inspector:
Location:	

Plan Sheet Number	Upstream Manhole	Upstream Sta. Number	Downstream Manhole	Downstream Sta. Number	Start Time	Start Pressure (psi)	End Time	End Pressure (psi)	Pass or Fail

Manhole Vacuum Test Form

City of Fayetteville

Test Date: _____				Contractor / Superintendent: _____			
Project Name: _____				_____			
City Project Number: _____				Engineer / Inspector: _____			
Location: _____				_____			
Drawing Sheet Number	Manhole ID	Manhole Sta. Number	Start Time	Start Pressure (inches of Hg)	End Time	End Pressure (inches of Hg)	Pass or Fail

City of Fayetteville